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# ENGINEERING AND MINING JOURNAL

*A Consolidation of Engineering and Mining Journal and Mining and Scientific Press*

METAL AND NON-METALLIC MINING · MILLING · SMELTING · REFINING · MARKETING

AT CHILE COPPER'S LEACHING PLANT

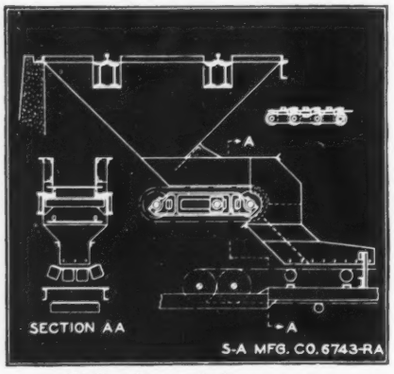
Chile: The World's Biggest Copper Mine — by A. B. Parsons

Principles of Geophysical Prospecting - by Sherwin F. Kelly

Magnetite Crystals in Sinters - by George M. Schwartz

Organic Flotation Reagents - by J. C. Williams

*A few of many installations and adaptations of self-contained feeders*

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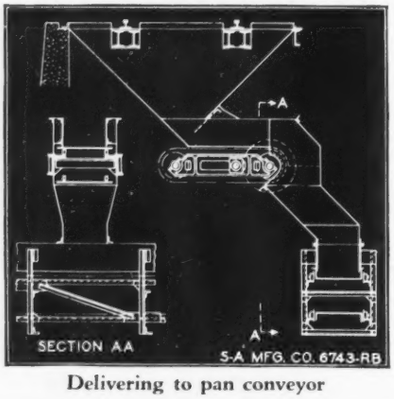


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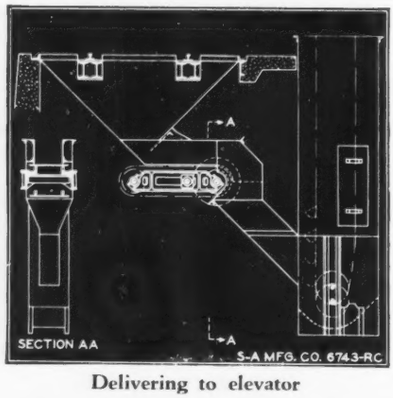


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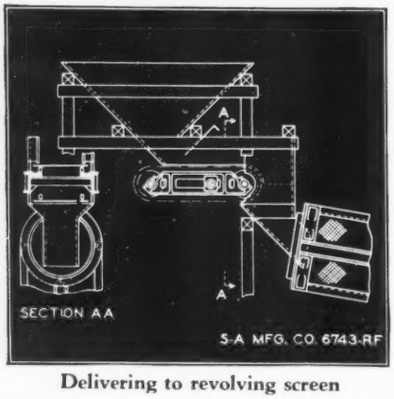


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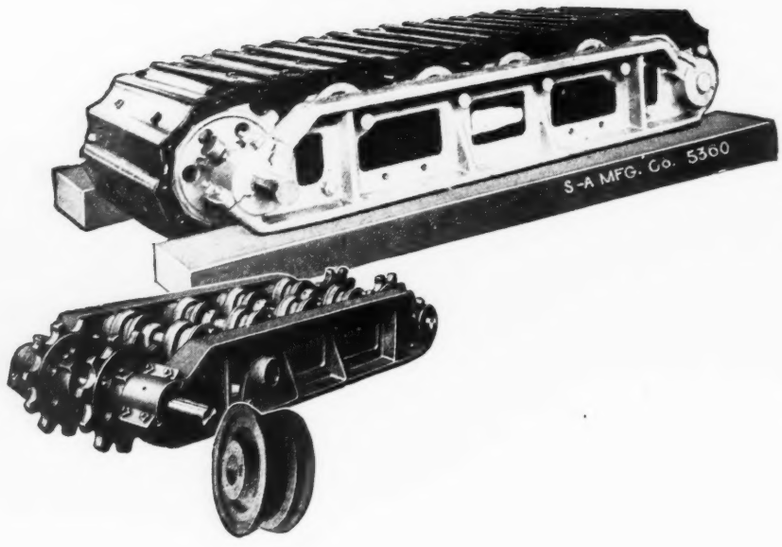


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*Volume* 124 New York, September 17, 1927 *Number* 12

ENGINEERING AND
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NEW YORK District Office, 285 Madison Ave.
WASHINGTON, National Press Building
CHICAGO, 7 S. Dearborn Street
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ST. LOUIS, Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Bouverie St., London, E. C. 4

Cable Address: "Machinist, N. Y."
Copyright 1927
By McGraw-Hill Publishing Company, Inc.
Publishers of
Engineering News-Record — American Machinist
Power — Chemical and Metallurgical Engineering
Coal Age — Engineering and Mining Journal
Coal Age News — Ingeniería Internacional
Electrical World — Electrical Merchandising
Bus Transportation — Electric Railway Journal
Industrial Engineering — Radio Retailing
Construction Methods — Electrical West
(Published in San Francisco)
American Machinist—European Edition
(Published in London)

The annual subscription rate in the United States, Canada, Mexico, Alaska, Hawaii, Philippines, Porto Rico, Canal Zone, Honduras, Cuba, Nicaragua, Peru, Colombia, Bolivia, Dominican Republic, Panama, El Salvador, Argentina, Brazil, Spain, Uruguay, Costa Rica, Ecuador, Guatemala, Chili, Haiti and Paraguay, $5 per year. Extra foreign postage, $3 (total $8 or 34 shillings). Single copy, 25c. Change of Address—When change of address is ordered the new and the old address must be given. Notice must be received at New York at least ten days before the change takes place. Published weekly. Entered as second-class matter June 20, 1879, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A.
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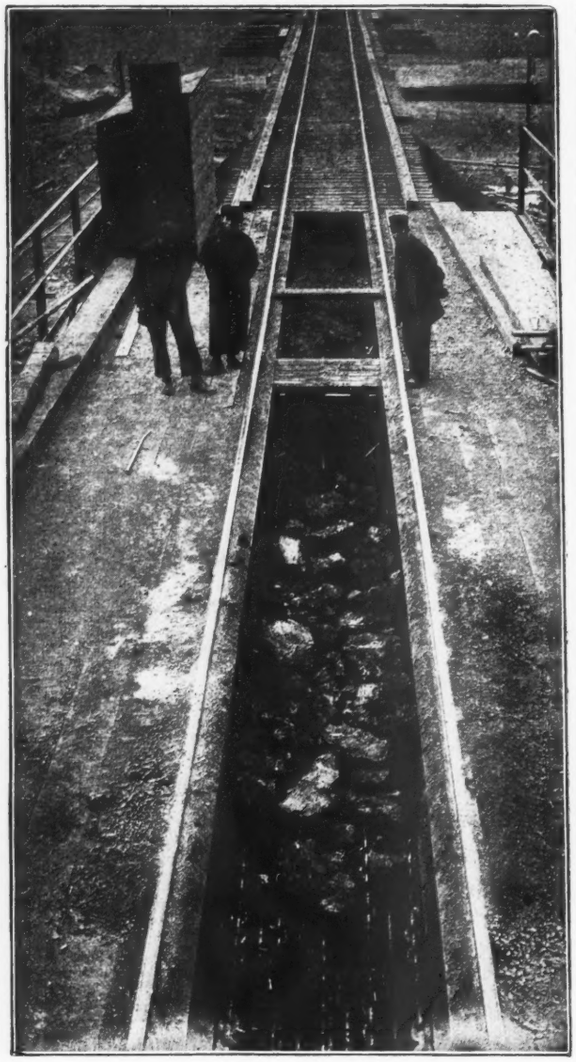

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VOLUME 124 — *New York, September 17, 1927* — NUMBER 12

## Electrical Engineers in Mining

TRULY this is an electrical age, and that fact is nowhere more in evidence than in the largest, lowest-cost, and most progressive mining and metallurgical operations. In view of this condition and tendency, the officials of some companies have overlooked the importance of having one or more high-grade electrical engineers on the staff. Few of the mine superintendents or metallurgists of the old school are in touch with the latest developments in applied electricity, and yet knowledge of these developments, if put to practical use, may well result in important economies. How many mine superintendents can discuss intelligently the relative advantages of electric and compressed-air motors for underground motive power, or can tell what the saving would be by carrying a high-voltage current down the shaft and distributing it by automatic devices near the load centers? How many millmen thoroughly understand the advantages of direct motor drive over belt drives, or know that push-button control is more than a convenience for a lazy operator? How many metallurgists have a clear understanding of where electric furnaces might be used to advantage in their plants; of the decreased cost of hauling away their slag by electric locomotives and dumping the pots by electric motors, all with remote control; or of the use of a synchronous motor-generator set of the latest design for transforming their alternating current to direct for electrolytic precipitation from leach solutions? Plainly, a knowledge of present-day electrical engineering is a necessity if practice is to be kept up to date in this era of active competition in cost-cutting, and the electrical engineer or the electro-metallurgist is an important man.

The Chile Exploration Co., an interview with the manager of which appears elsewhere in this issue, is an example of the modern trend in the utilization of power in mining practice. The entire plant is, or soon will be, electrically operated, and, in no small part as a result of this fact, it produces as efficiently as any other comparable operation in the world. It is popularly thought that to employ electricity so generally it is necessary to have cheap hydro-electric power. At Chuquicamata curiously enough, however, the electricity is generated from steam-driven turbines, with fuel that must be transported some 5,000 miles. The high-tension current, at 100,000 volts, is carried ninety miles, and is put to work through more than 1,500 motors, totaling over 150,000 hp. Huge electric shovels have here been adopted, as they have by Utah Copper, on the Lake Superior iron ranges, and in other districts; electric locomotives are superseding other types not so well suited to the peculiar conditions that are met here; and electric furnaces are used in the company's model foundry. These are only a few of the electrical applications that are of most interest. Naturally, authoritative judgment on electrical matters is required, and Mr. Wheeler, the manager of the Chile company, is both a mechanical and electrical engineer, rather than a mining engineer or metallurgist. Otherwise, electricity would probably not have played so large a part in the modernization of the plant.

Conditions at this Chilean plant, of course, are different from those elsewhere, and it may not be advisable to go so far in electrification at some other properties. It would not be at all advisable for a mine manager blindly to follow others and to decide that electric locomotives are desirable for him to buy because some other modern plants are adopting them; or to say that he is warranted in scrapping his present electrical mill equipment for automatic or push-button control. Trained judgment in these matters is required, which brings us back to the point already made concerning the advisability of having the best electrical engineering brains about a plant—even if only to decide that a proposed change in electrical equipment is not warranted.

## Concerning Medals

A CUSTOM has arisen of awarding medals to distinguished persons. This custom, borrowed from the military service, is observed by sundry professional societies; indeed, it has come to us with the sanction of the earliest associations of scientific men, such as the Geological Society, of London, whose Murchison medal, for example, perpetuates the fame not only of a pioneer geologist but of the worthy men to whom in later years the medal was awarded for especially meritorious work in the field of geologic research. In the same manner, and spirit, the Bessemer medal of the Iron and Steel Institute serves as a perpetual memorial to the inventor of modern steelmaking and to the metallurgists that have emulated his good example by contributing to the advancement of their art. Coming nearer home, the Fritz medal of the American Society of Civil Engineers and the Douglas medal of the American Institute of Mining and Metallurgical Engineers likewise remind us of the illustrious dead, and when awarded to our contemporaries the bestowal of these medals draws our respectful regard to the achievements of the distinguished among the living. Obviously, then, the establishment of an annual award of a medal in the name of a celebrated person serves to remind us of him whom we are glad to honor in memory, and it sets the stamp of contemporary approval upon a man that has followed in his footsteps worthily, for usually a medal is given for an achievement similar in quality to that of the individual with whom its name is linked.

Several medals were founded by friends as a memorial

to the departed, others are given by the living as a means of encouraging good work; to the latter category belongs the Saunders medal, the first award of which, last year, fell, most appropriately, to Mr. David W. Brunton, whose name, now linked with it, has doubled its honorific value. The professional societies have assumed for themselves, not improperly, the right to bestow such honors; thus the Institution of Mining and Metallurgy, in London, has its gold medal, not given in anybody's name, like the Fritz and Douglas medals, but now associated with the names of the many engineers of high character and notable achievement to whom it has been awarded; likewise the Mining and Metallurgical Society of America, small in numbers as it is, but representative of a high standard in mining engineering, has established a gold medal, which it awards annually, among its recipients being many leaders of our profession, notably the Secretary of Commerce.

Apparently, and as one would surmise, it is not always easy to select, or to agree in selecting, the person most deserving of any one of these medals. Commonly a committee is appointed to make the choice, and such a committee usually invites suggestions, for it does not sit *in vacuo;* on the contrary, it aims to be the sympathetic recorder of public opinion outside its own precinct; therefore it asks sundry well-informed persons to nominate the proposed medallist, or it awaits the unsolicited recommendations of persons that are moved to take action in behalf of an appropriate award. The method may be open to criticism, but such is the way in which these things have to be done in real life; people do not wait for a revelation from the archangel Gabriel; they sound their fellows, they throw out feelers, and they dredge in the shallow waters of public opinion. For in the bestowal of medals, as in life generally, "kissing goes by favor," and if the modest violet or the shy buttercup have their charm in poetry, it is a glaring fact that the splendid rose and the arrogant dahlia are more persistent in their claims to beauty. None of which is meant to be satirical; we manage our affairs, medal awards included, on the representative principle; not the despotic. No individual dares to be the sole judge in such matters, and even a committee feels its obligation to act as a jury anxious to have the evidence before it pronounces a verdict. Nor is any specific criticism intended as regards such awards as have been made; we may differ in opinion concerning some of them; that is inevitable; *tot homines, quot sententiæ*. In the main the awards have been fairly and properly made, for upon such fairness and propriety the reputation of a medal must rest.

One suggestion, however, we venture to make: is it not the tendency rather to set the seal on success than to put the laurel on merit? The European is said to reverence a title. Do not Americans worship success unduly? In our country at this time the successful professional man is usually also a rich man, because the recognition of skill in any professional vocation commonly connotes high fees and other chances of making money; in short, success is rewarded by money and esteem. Some of the medal awards have been granted merely to approve a recognition of achievement already accorded; so there comes the idea that it would be—shall we say—more fitting to select meritorious men less known and less affluent, but equally deserving of recognition, and men to whom such recognition would mean even more in the way of happiness than it means to those that manifestly have arrived at their goal. All the good work in mining and metallurgy has not been done by the captains of industry, the general managers, and the presidents of industrial corporations; has not some of it been done by men of high character and scientific insight that have known neither how to make money nor how to manage their fellow man, and therefore failed to win acclaim or to rise to posts of high responsibility and commensurate emolument? Would it not be delightful, would not the souls of John Fritz and James Douglas rejoice, to see the medals bearing their names awarded to a comparatively inconspicuous but greatly deserving member of the profession? Of course, being little known, such a one ordinarily would be outside the ken of the awarding committee, but if the rest of us would keep our eyes open with a view to participating in an act of social justice we might be privileged, with the committee, in doing something of which we might be proud.

## Maintaining the Diamond Market

PREVAILING CONDITIONS in the diamond industry of the Union of South Africa should not be considered alarming, according to statements made last week in New York City by the Minister of Mines and Industries for that country. This official pointed out that the Union was a "statutory partner" in the production of diamonds—participating to the extent of 20 per cent in the diamond sales. Assurance was given that existing and pending legislation was adequate to protect the industry, and, of course, this particular source of revenue of the South African Union.

The unprecedented production of alluvial diamonds in South Africa during the last year has caused apprehension in some minds. No ultimate benefit would accrue to the public, the industry, or to South Africa, if this production should be permitted to become such a factor that marketing agencies could not maintain current prices. The minister's words should help to improve the morale of the diamond market.

## Protection for Asbestos?

THE advisability of imposing a tariff upon a certain commodity, or of retaining it if it is already in effect, depends entirely upon the commodity. A tariff may be desirable in one case and unjustifiable in another. For example, a strong argument can be made for the tariff now on manganese; but the wisdom of the occasional proposals to protect asbestos in similar fashion is decidedly questionable.

The case of asbestos is not at all comparable to that of manganese. Abundant resources of asbestos exist in Canada. In May last the deposits furnished 16,261 long tons of the total of 16,908 tons imported into the United States. The small balance came principally from Africa. So long as Canada is able to meet the requirements of the United States, asbestos consumers in this country are in a safe position. They are in no danger of being cut off from their raw material supply as they might be in time of war if their raw material came principally from Africa. War between Canada and the United States is inconceivable. Granted that asbestos cannot be dispensed with, that it has no satisfactory substitute for important uses, those who seek protection for it

nevertheless cannot argue that the possibility of war emergency will justify such protection.

Under the circumstances, then, the only argument that can be advanced in favor of protection for asbestos is that it would foster an infant industry. But to this it may be answered that there is no point in fostering infant industries unless they are essential in time of war or will make for the continued or greater prosperity of the country in time of peace. The asbestos infant would not be called upon to defend its mother against the dangers that war precipitates. As for helping in time of peace, it is likely that a tariff on this non-metallic mineral would do more harm than good. True, it would help the comparatively few owners of asbestos properties. But to the manufacturers of asbestos products it would increase the cost of their raw material, thereby forcing up their prices and making foreign competition easier, unless here again the aid of the protective tariff were invoked against imported manufactured products, in which case the ultimate consumer would be the sufferer.

The net result of a tariff on asbestos would be either decreased profits to domestic manufacturers or higher prices to consumers, or both, accompanied at the same time by a general dislocation of the existing industry and with no advantage to the country as a whole.

Lack of a protective tariff need not be an unsurmountable obstacle in the development of an asbestos-producing industry in the United States. Arizona has important reserves of this mineral, which, it has been asserted, can be brought into production as soon as cheaper transportation and power are provided. A Western market for manufactured asbestos products is already in existence.

## Mount Morgan: A Victim of Circumstances

THE winding up of the Mount Morgan Gold Mining Co. marks the end of a great Australian mining enterprise. It has, since 1906, paid dividends amounting to £2,625,000 on its capital of one million sterling. The reserves of mineralized ground still amount to 8,000,000 tons of between 38 shillings and 40 shillings metal content per ton, but whereas in many parts of the world this would be good ore, it cannot be worked at Mount Morgan today, even by large-scale open-cut methods. The possible application of these was most fully investigated by an American engineer, Mr. E. E. Barker. It is owing to the findings in his report that the Mount Morgan directors have decided on the winding up of the company's affairs.

A point of the chairman's speech at the general meeting held on July 29 is especially noteworthy. He said: "A combination of short hours, high wages, and superior working conditions such as has been thought wise to concede in Australia has made copper production impossible at Mount Morgan with prices that have been ruling in the world's markets." There is probably much truth also in the remark made by one of the shareholders at the same meeting that the mine would be an asset in any part of the world except where, by Providence, it is located. Australian labor seems to be doing its best by legislation to strangle the goose that lays the golden eggs, and the fate of Mount Morgan, involving a township of 10,000 inhabitants mainly dependent on the mine, may well be cited as an example worthy of heed by those who would give everything to the manual laborer. The government of Mexico should glance at this latest development of the industrial situation in far-off Australia with particular interest and possibly learn therefrom something tending to curb certain excessive trends in its own concessions to labor.

## Germany's Bauxite Supply

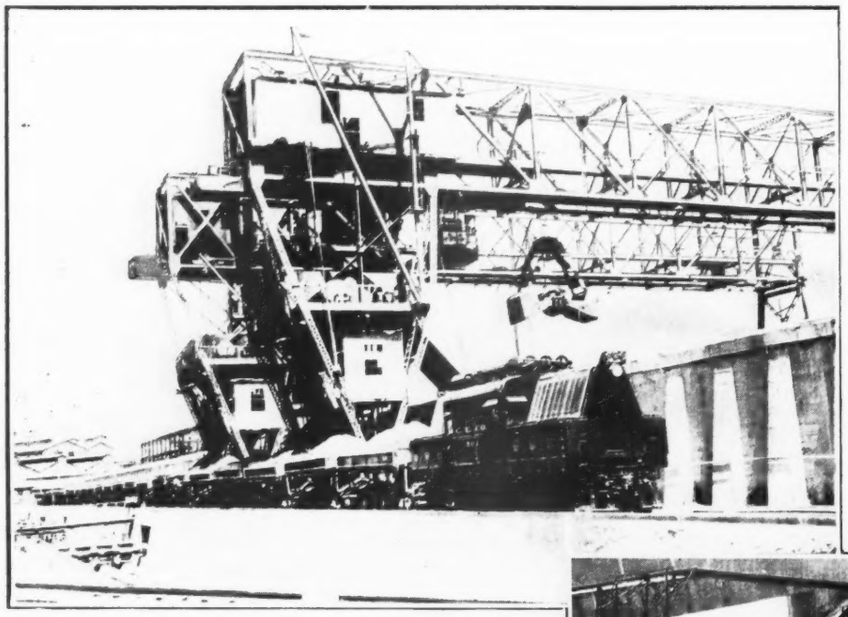
WHAT IT WAS that influenced the Aluminum Company of America to cut its price last January on all grades of ingots has never been divulged. For all that the reason has not been hard to guess. Of possible causes the increasing German competition has seemed the most probable. Germany, which before the war produced only 1,500,000 lb. of aluminum per year, now has an annual capacity of some 43,500,000 lb. and has steadily been increasing in prominence as an exporter. Furthermore, it has been whispered that the German industry is the one and only aluminum producing unit over which the American giant has no influence, direct or indirect. It would scarcely be surprising, therefore, if the Aluminum Company should attempt in some gentle, unobtrusive way to persuade the Germans that a working agreement of a kind might be mutually profitable.

That missionary work of this character is actually being done is indicated by the recent news that the Aluminum Company of America has acquired an interest in the Bauxit Trust A.G., of Zurich, which through its subsidiaries controls the bauxite mines of Hungary and other Balkan countries. It is from the Hungarian mines that the German manufacturers are now securing their supply of bauxite. If the control of the Bauxit Trust has passed into the American company's hands, the Germans may find themselves embarrassed.

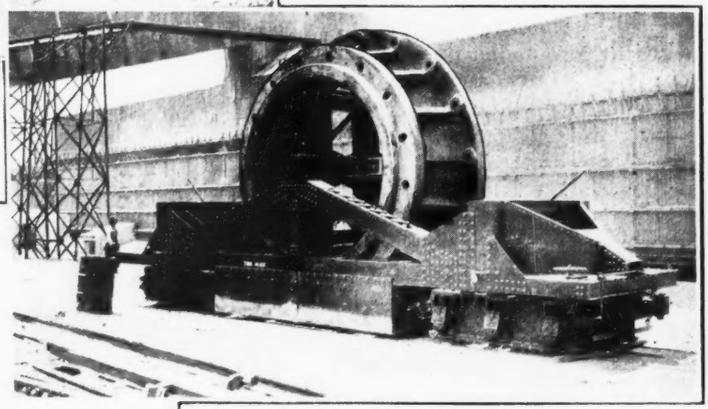
Up to last year the bauxite for German plants was brought from mines in Istria. The operations of the Germans in that Italian province ceased, however, when onerous mining laws were passed by Italy after the verbal tilt between Stresemann and Mussolini and the subsequent agitation appealing to Italian patriotism and the alleged need for conservation. This stoppage of mining work in Istria, it is said, also caused the Aluminum Company of America the loss of its investment in a Viennese corporation owning an Istrian deposit, but this was a profitable loss, indeed, if at the same time it was accompanied by the placing of a serious handicap upon an annoying competitor, Germany. Who it was that inspired the Italian agitation is a question that may be asked but hardly answered.

Since shipments of Istrian ore to Germany ceased, a rapid development of the bauxite mining industry in Hungary is reported to have taken place. Where would Germany get its bauxite, if its Hungarian supply were stopped? Part of it might be secured from Dalmatia in Jugo-Slavia, but there the ore is of poorer grade and transportation facilities to German plants are much less desirable than those that the Hungarian mines afford.

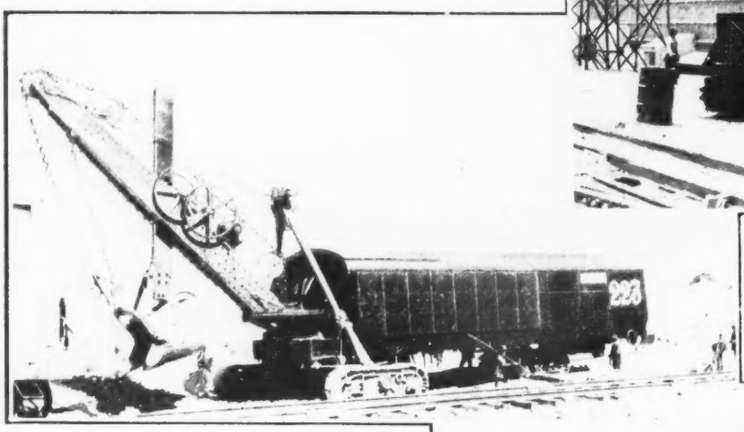
Possibly the Aluminum Company's acquisition of an interest in the Bauxit Trust of Zurich is not a move to bring the German aluminum manufacturers into line, but rather an attempt to secure a firm control of the desirable bauxite of the world. In either case, the future may be watched with interest. Perhaps aluminum will again command a price of 28 cents per pound.



*The unloading gantry, shown at the left, is one of four used for the removal of leached ore. Discharge is made into 12-yd. side-dumping cars drawn by a 70-ton electric locomotive. The clam-shells have a capacity of 12 tons*

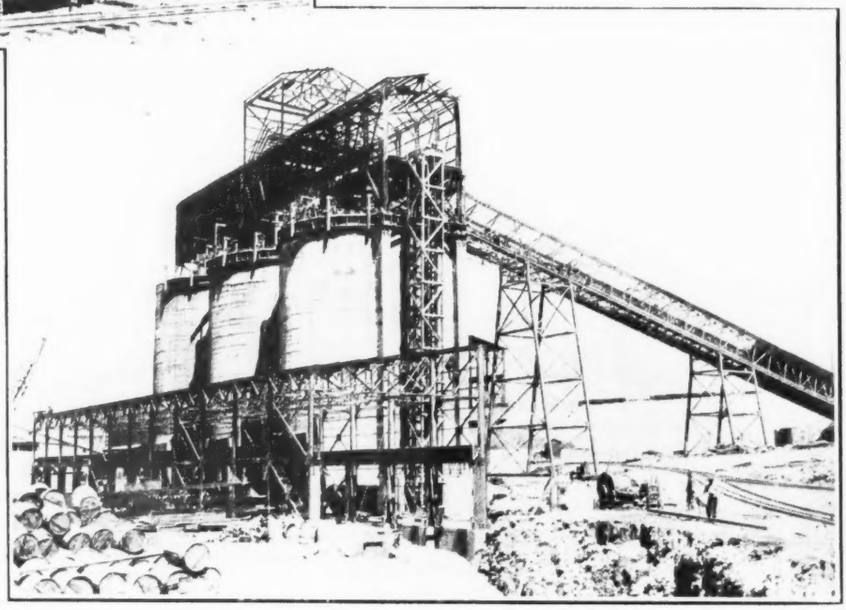


*Below: One of the smaller shovels converted to electric drive, and with a caterpillar truck base*



*Above: A 30-in. gage special trussed car to transport heavy parts, such as this lower top section of a 60-in. gyratory*

*To the right are shown the ore bins and construction work in connection with the new secondary-crushing plant, where the ore is crushed to at least $\frac{3}{8}$ in. for subsequent leaching*



## *Some of the Equipment at Chuquicamata*

# *Chile: The World's Biggest Copper Mine*

## *An Interview With Burr Wheeler*

By A. B. Parsons
*Associate Editor*

TO THE usual distinctions that it has enjoyed hitherto in the mining world, the Chile Exploration Co. recently has added a third. First, it owns at Chuquicamata the largest known deposit of copper in the world—about 700,000,000 tons of ore with an average content of 42 lb. per ton. This 15,000,000 tons of copper is twice the amount that is calculated to be contained in the combined reserves of the Utah Copper mine, at Bingham, and the many deposits thus far developed by the Union Minière in the Belgian Congo. Of course, the possibilities of further development in the Congo are enormous. Chile also has in the Utah Copper Co. a close rival so far as ore reserves are concerned. According to the latter's most recent report, its reserves may equal those of the South American company at no very distant date, but it should be borne in mind that Chile's ore is much richer. At the moment Chile stand foremost in this respect. Whatever ore deposits those regions of the world that are as yet unprospected and undeveloped may have concealed that of Chile remains for the moment without a peer. In the summer just past the company put the finishing touches to a construction program, started in 1925, that has increased the capacity of mine and reduction plant to 375,000,000 lb. of refined copper per year. Just how soon it will be considered advisable to increase the current rate of output, of about 200,000,000 lb. per year, is a question that not even the Anaconda officials, who guide the destinies of Chile, can answer; but the plant and equipment are there when the time comes, and the Chile enterprise stands forth as potentially the world's largest producer of copper. The foregoing is not part of the interview that I am reporting. Burr Wheeler, general manager for the Exploration company, in charge of all operations in Chile, is much too modest to call attention to these facts. Indeed, except for the good offices of H. C. Bellinger, vice-president in charge of operations, and his assistant, W. B. D. Motter, Jr., there would have been no interview. They convinced Mr. Wheeler, who is spending six months' vacation in the United States after completing the big construction projects, that the mining profession would be interested in a brief account of the recent work and a description of conditions in Chile from one who spoke with the authority of first-hand knowledge. First, however, I want to introduce Mr. Wheeler. He was born in Michigan long enough ago to have graduated as a mechanical engineer from Michigan State College in 1903. Thereafter he took one year of electrical engineering at Columbia University, from which he emerged to join the staff of the only company by which he was employed up to the time of going to Chile. For ten years he worked as an electrical engineer for Westinghouse, Church, Kerr & Co. He had a good job as jobs went at the time; but he wanted a better one. The Chile Exploration Co. was just starting the equipment of its property, and Percy Thomas, who was consulting on electrical matters for the company, happened to ask Mr. Wheeler how he would like to go to Chile as an assistant electrical engineer. A trip to Chile was more of an adventure then than it is now; but Mr. Wheeler very promptly decided to go, and he has never regretted the change. That was in 1913. In 1919, after several intermediate promotions, Mr. Bellinger, who was then general manager, made him assistant general manager; and when Mr. Bellinger came to New York in 1920 Mr. Wheeler took the place that he has since held. According to his associates, Mr. Wheeler is versatile in his talents. He has great ability as an organizer. Furthermore, to his knowledge of electrical engineering he has added by close study a familiarity with the other technical operations that are under the direction of his subordinates. There are few details with which he is not intimately acquainted. It is interesting to note that the policy of promotion from within the ranks has been followed at Chuquicamata. Also, that the transfer of control from the Guggenheim interests to Anaconda occasioned little or no disruption of the staff in Chile. In reply to a

BURR WHEELER

question on this point Mr. Wheeler said that I might draw my own conclusions from the following: "The assistant general manager is L. W. Kemp, who went to Chile thirteen years ago from Grass Valley, Calif., as a

*320-B Bucyrus electric shovel, 8-yd. dipper, Ward-Leonard control*

junior engineer on the mine staff. Mathew Sample, the present mine superintendent, has been with the Exploration company for twelve years, coming directly from a railroad job in Bolivia. The superintendent of the reduction department is C. K. Topping, whose career with the company commenced thirteen years ago. C. M. Hoebecke is now chief engineer, and has supervision over the shops, power plant, and construction and mechanical work of all kinds. Felix Layat, who has been in Chile for more than six years is resident engineer in charge of the power plant at Tocopilla."

In these days, when American mining enterprise is spreading more than ever to remote portions of the world, the thoughts of engineers—the younger ones in particular—are turned perforce to living conditions in foreign mining regions. Mr. Wheeler sketched the situation as follows:

"The most striking feature of the country around the mines is, possibly, the almost complete absence of rain or snow and the entire lack of vegetation. Obviously, we had to supply as well as we could the comforts that nature did not provide, or the best substitutes that we could devise. There are about 175 American citizens and perhaps twenty-five British on the payroll, and of these fifty have their families with them. With a colony as large as this we can afford to devote a good deal of effort to making community life attractive. The clubhouse compares favorably in size and equipment with anything of its kind in an American town of 100,000 population. It has excellent accommodations for lounging, dramatics, dancing, swimming, and all kinds of indoor athletics; and a modern restaurant. Social life centers around the club.

"Golf is played under some handicaps; but it is played nevertheless. Most people find the sand fairways more difficult to negotiate than grass, but the greens are easier. They are constructed with a sub-grade of stone overlain by a thick layer of sand mixed with a heavy oil that hardens. The top surface is a layer of carefully graded silica sand mixed with light oil that does not harden but that prevents the sand from blowing away. To serve the dual purpose of marking the location of the hole and smoothing the path from ball to cup, a wooden scraper is provided at each green. The course has been found to be an excellent nerve tonic not for the men alone but for the ladies. This is a good thing for, as is the case in isolated communities the world over, things get on one's nerves more easily than elsewhere. Possibly golf has had some influence in reducing the "turnover" in the ranks of the staff. Contracts are for three years, but there recently has been a growing tendency to sign for further periods."

On being asked whether the climate had any other bad features apart from its extreme aridness, Mr. Wheeler replied: "No. It is really very healthful. The elevation at 'Chuqui' is 9,000 ft. and the range of temperature is not wide enough to make either very hot or very cold weather. Diseases are not prevalent; typhoid, for example, is particularly infrequent, as a result perhaps of the provision of excellent water from sources in the mountains about 60 miles away. Chuquicamata lies about 160 miles inland northeast of the port of Antofagasta. The company has extensive irrigated truck farms of its own at Antofagasta, where a large variety of vegetables is grown for use of employees. The company operates its own abattoir and of course has its own refrigeration plants. The beef cattle come from the Argentine, crossing the high Andes on the hoof. The trip is a hard one, as can be imagined, and it is necessary to 'shoe' the steers just as horses are shod, or their hoofs would be worn completely away. I am inclined to think that this practice is unique."

One of the important phases of mine operation anywhere is the availability and competence of the workmen in the country. Discussing this matter Mr. Wheeler said:

"We have on our payroll about 6,000 Chileans, a large proportion of whom have permanent homes near the

*One of the new combination storage battery-third rail electric locomotives*

company's plants. These homes are built and owned by the company. The Chileans average very high as workmen. They make excellent mechanics, and are particularly skilful in operating machinery. Years ago we

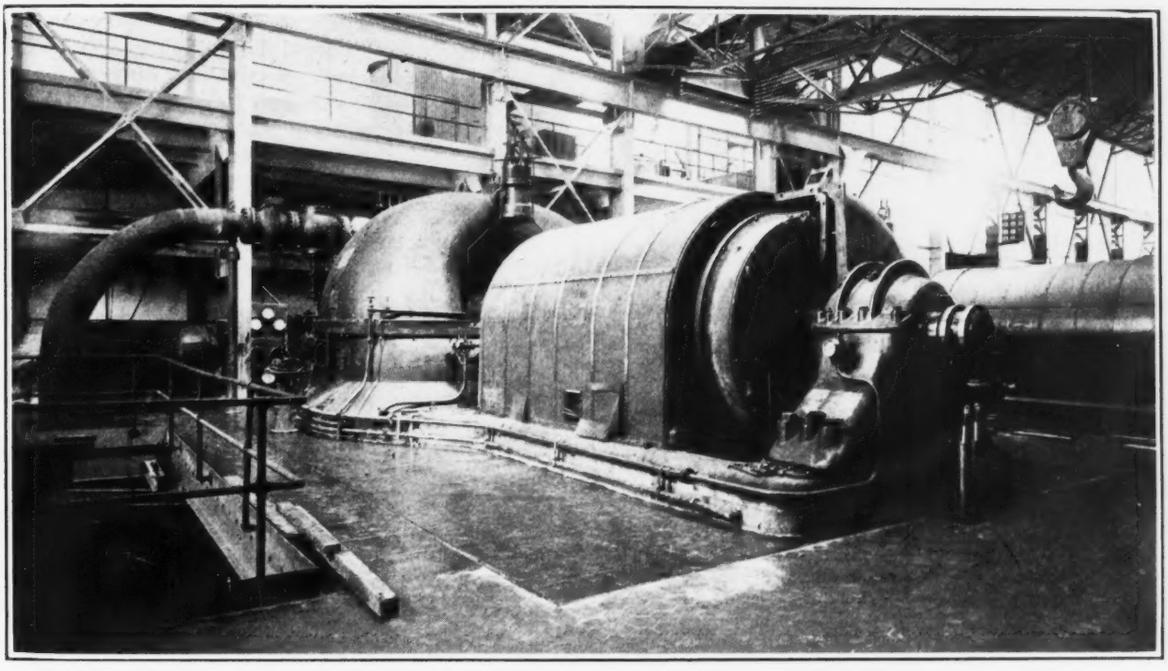
thought that we had to have Americans as engineers on the locomotives and shovels, but we now trust all that kind of work to Chileans, with highly satisfactory results. Most of the foremen likewise are Chileans, as can be surmised from the comparatively small number of British and American employees.

"About 18,000 Chileans, including the families of the workmen, comprise the population of Chuquicamata. A great deal of effort—and successful effort—is expended in making living conditions attractive to these people. They are taught the importance of sanitation; the town has a sewer system, and public bath houses are numerous enough to let everyone have as many baths as he likes. Two public schools are attended by 1,700 children who, besides 'book learning,' get instruction in manual training, athletics, and personal hygiene. Among other requirements is one that their hair be cut at appropriate intervals. A remarkably complete steam-heated hospital, with modern equipment and 125 beds, and a separate maternity hospital are among the features of Chuquicamata.

"Payment to the workers is in very large measure made on a contract-and-bonus basis, the average earnings being in the neighborhood of 13 Chilean pesos, or the equivalent of a little more than $1.50 in American money, per day. To assist the workmen in making their earnings go as far as possible the company conducts *pulperias,* or general stores, where staple goods are sold at cost. Competition by independent merchants is welcomed; but the net result is that the wage earner is not exploited by Chilean merchants. There is naturally a certain amount of drinking, carousing, and fighting, but in this respect conditions are improving. I believe no one will question the accuracy of the statement that our employees are better off than they ever were before. The fact that we have an ample supply of good workers indicates that they are in general satisfied."

Before touching on some of the interesting details of the recent program of expansion, including changes designed to increase efficiency and lower production costs, it may be well to outline very briefly the main features of the gigantic enterprise. The orebody is a mass of mineralized granite lying close enough to the surface to warrant mining with steam shovels. At Chuquicamata however the "steam" shovels, twenty-one in number, are operated by electricity, the largest being equipped with 8-cu.yd. dippers and weighing 335 tons. Churn-drill holes, or, in some instances, adits driven into the benches, are used for blasting. The average shot loosens 200,000 tons of rock and as much as 1,000,000 tons has been broken.

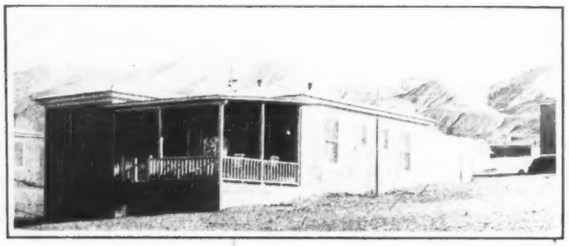
Transportation of ore and waste is accomplished by a standard-gage railway system with 48 miles of interplant track. Rolling stock includes 380 gondola cars of 70-ton capacity and 46 oil-fired steam locomotives. One of the recent developments is the substitution of electricity for steam power. This will be mentioned presently. At the reduction plant, which, as now constituted, has a capacity for 55,000 tons per day, the ore is crushed to about $\frac{3}{8}$-in. maximum size in two stages of gyratory crushers, followed by Symons disk crushers. It is then delivered by means of an elaborate belt conveying system, comprising 18,485 ft. in all, to reinforced concrete, mastic-lined leaching vats. Each of these holds 11,000 tons of ore. A six-day leach with dilute sulphuric acid dissolves the copper. During 1926 the ore averaged 1.516 per cent copper and the net recovery averaged 88.34 per cent. The first leach liquor to emerge, known as the "strong" solution, is treated for the removal of chlorine by agitation with cement copper, after which it goes to the electrolytic precipitation plant. The metal is deposited as 150-lb. cathodes, which are transported to the refining furnaces for melting, skimming, blowing, and poling ready for shipment to Antofagasta and export to the markets of Europe and the United States as finished copper.



*New 20,000-kw. turbine recently installed at Tocopilla*

An important part of operations naturally is the generation and distribution of electric power. With the exception of the steam locomotives, now being replaced, the entire operation is electrically operated. The power

plant is situated at Tocopilla, 90 miles distant on the coast. The fuel is crude oil, coming at present entirely from California, supplying steam for the operation of five turbo-generator units with a total capacity of 90,000 kw. At Chuquicamata there are installed 1,553 motors, with an aggregate capacity of 157,000 hp. In addition, power must be supplied to the electrolytic plant. It seems quite appropriate that the manager should be an electrical engineer, in view of the importance that electric power plays in operations. One might be inclined to wonder if some predilection to the use of electricity on the part of Mr. Wheeler might not have been a factor in the decision to change over so completely to that medium of power supply. In any event, it may be said



*Type B (enlarged) house, "Ford" type of dwelling for minor executives with families*

with conviction that no change has been made unless a saving has been assured. Regarding the use of electric locomotives for example Mr. Wheeler explained:

"The 75-ton locomotives will be combination storage battery-third rail units. On the benches, where the tracks are temporary, power will come from storage batteries. On the main line, third-rail power will be used, the batteries being recharged simultaneously. The longest haul from mine to mill is about three miles. We have demonstrated conclusively that a material saving over any other type of locomotive will be effected, in view of all the conditions obtaining at Chuqui."

I asked Mr. Wheeler to outline other developments in practice that have been introduced within the last few years. He said:

"In addition to electrifying the shovels, we have replaced all of the railroad truck mountings with caterpillar tractors, with consequent economy. This does not apply of course to the three full-revolving 335-ton electrics. Another change is the gradual adoption of liquid oxygen as virtually the only explosive to be used in the mine. We are convinced that this is the thing, and as rapidly as the equipment for preparing the explosive can be installed we will increase the use of it until other kinds of explosives are put in the discard."

### Improvements in Crushing Plant Units

In erecting additional crushing-plant units to reach the capacity required for the enlarged scale of operations some changes in design were made. "For example," said Mr. Wheeler, "in the original coarse-crushing plant a hinged tipple and jaw crushers were provided. In the new unit is a rotary dumper with a capacity of two 70-ton cars at one turn; and each car dumps into a 60-in. gyratory weighing 960,000 lb. Another improvement is the installation of Symons vertical-shaft disk crushers, whereas the original units were equipped with rolls. The Symons machines are much more efficient on the hard ore that we have to crush. Incidentally, in the new coarse-crushing plant there is not a single belt drive. Direct-connected motors, inclosed speed reducers, and various improved types of gears are used. We think we have made very few mistakes indeed in this new plant, but one can never tell when even better machines will be manufactured."

As in the instance of the mine and mill, the improvements in the leaching and precipitating plants have been in the direction of developing and installing more efficient equipment and making minor changes in method rather that any essential modification of the process. In this connection Mr. Wheeler said:

"Strong leach solution formerly was de-chloridized by passing it through a cylindrical tube-mill-like machine containing shot copper, after which the cuprous chloride was allowed to settle. The present practice consists of agitating the solution in large concrete pneumatic agitators of the Parral type. This device was first developed in Mexico for the agitation of cyanide pulps. The lift pipes are arranged around the periphery, the emerging pulp being directed horizontally and tangentially so as to give a swirling motion to the contents of the tank. The necessary cement copper is prepared by precipitation from acid solution on scrap iron.

### Wood-stave Pipe for Acid Liquors

"An important source of economy is the substitution of home-made wood-stave pipes for handling the acidulous copper bearing liquors. The presence of nitrates shortened the life of lead lining and was a source of great expense. Ordinary Douglas pine is imported, and from this pipes ranging from 6 to 24 in. in diameter are fabricated. Insoluble anodes of silicon-copper alloy were developed here a few years ago as a substitute for the ferrosilicon anodes that had been used formerly. They, too, are made locally, being cast from melts made in the electric furnace. The foundry, by the way, is quite an institution. In addition to anodes we make brass, iron, and in some instances steel castings, all of the melting being done in electric furnaces."

In answer to a question as to the source of the large amount of equipment used at Chuquicamata and Tocopilla, I was assured that except for some of the original electrical installation everything had been imported from the United States.

Fifteen years ago the site of the Chuquicamata of today was a silent barren waste of low sand-swept hills. Of permanent inhabitants it had none. Today it may still be sand-swept on occasion; but it is never quiet, and the barrenness has been assuaged so far as humans have been able to do so, with little or no co-operation from nature. The steam shovels are never silent; ore trains are constantly moving; the crushers are perpetually grinding; and the furnaces burn eternally—or so it seems. The mine is at the north end of the district. Quarters for the Chilean workers are at the south end, 6 miles away. There is constant traffic back and forth afoot, in motor buses and by automobile. Twenty thousand souls, assisted by 120,000 hp. of electric energy harnessed in the most effective way, are laboring endlessly to win copper from the biggest deposit yet found on this earth of ours. One wonders whether Mr. Wheeler, as he vacations here in the United States, occasionally finds himself longing to get back in the thick of it. His is not the least romantic job in the world and certainly not the least worth while.

# *Principles of Geophysical Prospecting*

By SHERWIN F. KELLY
*Mining Geologist and Geophysicist, 25 Broadway, New York*

PROSPECTING has, as its primary purpose, the discovery of certain valuable minerals, or of geological formations indicating a reasonably safe inference that such minerals are present, though hidden. The first requisite in this work is that the various minerals be distinguished, one from another, and that different geological formations be recognized and their characteristics known. All this requires a knowledge of the characteristics, general and specific, of minerals and rocks. Such knowledge may be only partial, and ordinarily must embrace those easily noted properties that are essential to the recognition of mineral and rock types.

The ordinary prospector observes only the more salient things, such as color, luster, weight, hardness, structures, and related factors. In brief, the things that affect the senses of sight and touch are the ones that interest him.

The trained geologist goes a step further, and knows more thoroughly those same properties, as well as others requiring special study. He utilizes knowledge of the crystal systems, cleavage, and specific gravity to distinguish the various minerals, and makes use of the chemical characteristics by means of the blowpipe, chemical analyses, and assays. The particular effects produced on light waves by various minerals, as observed through the petrographic microscope, serve to distinguish species otherwise difficult to differentiate. The microscope is also called in for the purpose of studying rock types, opaque ore minerals, plastic material, and so forth, solving questions of origins, order of formation, progress of alteration and replacements, and many others.

Practically all the above-mentioned procedures could logically be called geophysical because they involve, to a certain extent, the study of properties ordinarily investigated through the science of physics (or chemistry). This may seem somewhat like pointing the obvious, but to so many people the term "geophysical prospecting" implies a new study, recondite and mysterious, that it seems well to show at the outset that one is dealing merely with a logical development from the already familiar, an inevitable extrapolation from past knowledge and practice.

TO THE average mining engineer magnetic prospecting (dip-needle work) is a familiar method of locating magnetic minerals, such as magnetite and pyrrhotite. With increasing sensitivity of the magnetometer used, the field of operations can be extended to include the differentiation of rocks differing in their weak magnetic properties to only a minute amount. This procedure makes use of a physical property, magnetism, and is, therefore, geophysical prospecting in the accepted meaning of the term.

The use of the electroscope to find lost radium tubes, and to discover radioactive minerals or water, is another form of geophysical prospecting.

What more logical, then, than to attempt to use other characteristics whose study falls within the field of the physicist? Relative densities of geological formations may be studied through their alteration of the gravitational field. The refracting and reflecting effects of rocks and ores upon transverse and longitudinal oscillations (of sound waves and miniature, artificial earthquake waves) are observed by means of seismographs. Some attempts have been made in certain "radio" methods of prospecting to make use of the refraction and reflection effects of various formations upon the electromagnetic "Hertzian waves." This introduces the question of the investigation of electrical properties, at the present time one of the most fruitful fields of study in geophysical prospecting. It is obvious that the study of different electrical properties of geological formations can constitute various methods of geophysical exploration. In this respect, the electrical conductivity, the electrical capacity as well as the electromagnetic properties of the subsoil can be taken into consideration.

BRIEFLY, prospecting involves the observation of certain properties, possessed by minerals, usually physical and of varying degrees of complexity. Proceeding from those easily observed to those requiring scientific training and technical skill they are:

Reflection and absorption of light (luster and color), hardness, weight and specific gravity, molecular arrangement (crystal system and cleavage), refraction and polarization of light (mineralogical studies with petrographic microscope), chemical composition (blowpipe and chemical analyses), magnetic field (dip-needle surveys), density (gravimetric studies), rigidity (seismological work), and lastly, electro-magnetic permeability, induction and capacity, electrical resistance and electro-chemical activity, all depending more or less on *electrical conductivity*.

Most familiar of the geophysical methods is the magnetometric survey, which is of comparatively ancient application. It is believed that the dip needle was used as early as 1760 to locate iron ores in New Jersey, and beginning with John Lock's work, in the United States in 1846, studies were made of the relationship between main tectonic features of the earth's crust and anomalies in the terrestrial magnetic field. Not until 1879 were the simpler laws of the magnetic method worked out, by T. R. Thalen, at least in regard to their

Reprinted from the *Financial Post* Survey of Mines.

application to prospecting, although the method was in practical use prior to that time.

Since then the workers in this field have been too numerous to mention, and the system has been proven of wide utility. It can now be used to locate not only magnetic orebodies, but to trace buried granite ridges, locate hematite masses, and under favorable conditions, salt domes, and other formations.

The simplest form of magnetic survey is with the dip needle, which is merely a compass arranged so that when in use the needle swings in a vertical plane about an horizontal axis. The apparatus is held so that the plane of swing of the needle is at right angles to the magnetic meridian. Thus the vertical component of the magnetic field due to the disturbing magnetic body is read directly. Every region has its normal local magnetic influence, and it is only where the observed effect differs widely from the normal that the presence of magnetic ores is suspected.

The dip needle is not capable of refined work, and accordingly more delicate instruments have been devised to measure more accurately a larger number of factors—namely, inclination, horizontal intensity, and declination or angle of direction of the horizontal intensity with the astronomical meridian.

For the location of useful magnetic deposits, it is frequently satisfactory to know merely the horizontal and vertical intensities of the field, and for this the magnetometer is usually sufficient. In this instrument a movable magnet is used to compensate the earth's field, and thus the vertically swinging needle is brought finally to rest in a horizontal position. The position of the movable magnet is read, and this indicates the vertical intensity of the field. With the long axis of the needle at right angles to the magnetic meridian, this vertical component is directly due to anomalies produced by magnetic deposits.

Local variometers are used for more delicate work, particularly the Adolf Schmidt type. To measure the variations of the horizontal intensity a needle is swung on a quartz knife edge, so that it stands vertically under the influence of movable compensating magnets. Deviations from this position are read by means of a spot of light reflected on a scale by a mirror fastened to the needle. Variations in vertical intensities are obtained by a similar device, but with the needle lying horizontally. Vertical intensity is at a maximum over a magnetic mass (of S. polarity in the northern hemisphere) whereas the horizontal intensity and inclination show their maxima of variation near the edges. For all delicate work correction must be made for local and temporal variations.

A SECOND natural property, not depending on the creation of an artificial field of force, is that of mass and is measured by the pendulum, or by the Eötvös torsion balance. The torsion balance bearing his name was used by Baron von Eötvös, professor of physics at the University of Budapest, in 1887, to amplify and extend gravitational surveys. It was a modification of the Coulomb torsion balance, in use in scientific laboratories since the eighteenth century to investigate gravitational and electrical attraction. The advantage of the Eötvös machines is its astounding sensitivity, and the fact that instead of measuring the total gravitational field, thus showing variations only as small differences between large values, it measures the variations directly as the actual small differences. The sensitivity of the instrument is so great that extreme care must be taken in preparing the "set-up." The ground must be leveled for several yards around it, and the presence of trees, ditches, and other objects must be rigidly avoided. The minimum force which the instrument is able to measure is represented by the weight of half a millimeter of a wire reaching from the earth to the moon and weighing in all but one gram.

Briefly, the balance consists of a beam, suspended at its middle by a fine wire, which is free to rotate in a horizontal plane about this point of suspension. The beam is accurately counterbalanced by a weight at either end, one attached directly to the beam, and the other suspended by another wire from the opposite end.

Ordinarily the direction of the earth's gravitational field at two neighboring points is thought of as being represented by parallel lines. Such is not the case ordinarily, and the field acting on the attached weight is not parallel to the one acting on the suspended weight, especially if there is an important disturbing mass nearby. This angularity of direction produces, of course, a horizontal component exerting a torque upon the beam system. As a result the system revolves a minute amount until the torsion in the first-named suspension wire balances the torque. This twist is recorded photographically.

THE balances are made with two parallel beams, oriented in opposite directions, thus making each reading a double one. About an hour is required for a reading. Since readings must be taken in three azimuths or more, more than three hours are generally required for a station. Hence, with the time necessary for dismantling, transporting, and setting up in a new position, it is seldom possible for an instrument to make more than three stations per day. Great precautions must be taken to protect the instrument against temperature changes, radiation, and the presence of disturbing masses.

The field of application of this method of geophysical research lies in the study of large masses, not too deeply buried, of density different from the surrounding terrain. Salt domes have been located by the balance, both in Europe and the Gulf Coast oil field of the United States. The salt core, having a lesser density than the rocks it intrudes, produces a gravitational attraction abnormally low, with the horizontal component directed *away* fram the dome. In the case of a dense cap rock on top of the dome, the reverse is the case, the more massive material being nearer the surface, and completely obliterating the effect of the deeper salt. Depth plays an important role in torsion balance work, and its usefulness at depths greater than 1,500 ft. is often questionable in the search of salt domes.

Where tectonic disturbances, such as folding into anticlines and synclines, or faulting, have brought formations, possessing a density markedly different from the inclosing strata, abnormally close to the surface, such folds and faults may be traced in favorable cases. The same applies to old valleys buried beneath later alluvium. Orebodies consisting of heavy minerals, such as the sulphides, iron carbonate, and the like, have also been studied in a very few cases.

The method suffers from the many disturbing elements which may enter into the data, and which should be corrected. This can be done when the causes are visible, such as surface irregularities. But a boulder in glacial till may throw the readings completely off, as will an old, irregular erosion surface that is but thinly covered. Also, in a region of tectonic disturbance,

(folded regions, and so on), the balance is ordinarily useless, the phenomena being too complicated.

Other methods using naturally created phenomena are those depending on radioacting measurements, and on observations on the variations in temperature within the earth's crust (geothermic readings). These are of such limited application that there is no point in discussing them here.

THE PROBLEM of geophysical prospecting by artificially induced effects can best be introduced by discussing the earth wave travel, or seismic method. Most people are aware in a general way of the *modus operandi* of seismographic observations. Sudden dislocations in the earth's crust send out vibrations or waves which travel around and through the globe. Differences in elasticity between crust and core produce refractions of these waves, altering their courses and times of arrival at a given distant point.

The waves are recorded by the relative agitation they produce between a pendulum of great inertia and a recording cylinder. Levers are used to magnify this relative motion, which is marked on smoked paper in the form of wavy lines.

There, in brief, is the seismic method. Miniature earthquake waves are created by setting off a charge of dynamite. Seismographs are set up around this point, up to ten miles away, and the arriving waves recorded photographically.

As the earth's crust is notoriously heterogeneous, the waves are altered by the varying elasticities and densities of the rocks through which they pass. A formation of a given rigidity will have a definite effect on the speed of a transmitted wave. The vibrations will undergo refraction, reflection, retardation, or acceleration, according to the physical properties of the transmitting media. These changes will be recorded at the observing stations. A study of the character of the waves and of the times of their arrival enable the geophysicist, in many cases, to deduce conclusions about the subsurface geology. By this means faults can be traced, as well as contacts between different strata and between alluvium and bedrock. The method has had especially wide application in the search for salt domes in the Gulf Coast field, replacing almost entirely the torsion balance in that region. Recent developments there indicate that the method can be applied to exploration at very great depth, and that deep-seated domes can be successfully located.

The study of seismology has not yet arrived at a point which will permit of a standardized procedure in this method, and much remains to be done. A geological study must go hand in hand with the wave study, or erroneous conclusions may be drawn. To mention but one point, the moisture content of rocks affects their rigidity, and hence their transmission of earth tremors.

A modification of this procedure was developed with much success by Fessenden. Instead of dynamite a sound-producing device is used, and as receivers, a series of microphones.

PERHAPS the widest application of the study of artificially applied fields lies in the domain of electricity. The flexibility of electrical methods is their great advantage, due to the ease with which the strength of the applied field can be varied within wide limits. The first successful study of an artificially created electrical field in prospecting for ores was made by Prof. Conrad Schlumberger, of the Paris School of Mines, about 1912. He investigated both direct and alternating current for the study of the electrical conductivities of geological formations, and decided on the direct as holding the greatest possibilities. He patented the principles of his methods in 1912. The following year experiments of the same nature with alternating current were described in Sweden, but not until 1918 was any considerable success attained with this method, when Lundberg and Nathorst developed their idea of "linear electrodes" for passing alternating current into the ground.

Whether alternating or direct current be used, the efficacy of the methods depends upon the difference in electrical conductivity between ore and country rock, or between one geological formation and another. When an electrical current is passed through an ideally homogeneous medium, its distribution is in accordance with known laws. As before mentioned, the earth is not homogeneous, and therefore the distribution of the current is irregular when the transmitting medium is the rock of the crust. These perturbations of current distribution must be observed, studied, and interpreted in order to deduce the character of the disturbing medium.

THE first successful procedure worked out to accomplish this was the study of the equipotential surfaces and curves, as devised by Schlumberger. When a current is passed between two contacts in any medium, homogeneous or not, there is a flow of current from one point to the other and this produces a fall of potential between the two above-mentioned contacts. All points at exactly the same potential with respect to one of these contacts constitute an imaginary surface lying within the medium, and called an "equipotential surface." The trace of the intersection of this surface with the surface of the earth—i.e., its "outcrop"—is an "equipotential curve." When the terrain is homogeneous these surfaces and curves are perpendicular to the direction of current flow and their form is known *a priori*.

The equipotential surfaces remain regular only as long as the ground is homogeneous. When distinct differences in conductivity occur, irregularities appear in these surfaces, they being repulsed by conducting bodies and crowded together in resistant ones. This spreading or crowding is studied at the surface of the ground by tracing the equipotential lines. In the Schlumberger method this is accomplished by means of a potentiometer and two specially designed "non-polarizing" electrodes, used as a "searching circuit." The electrodes shunt off some of the ground current, which then passes through the potentiometer, where its voltage is measured. When no potential is recorded, the two electrodes are on the same equipotential line.

The presence of a highly conductive mass, such as an orebody, distorts the equipotential lines, even if the mass be buried several hundred feet deep. When it is realized that sulphide ores are usually 1,000 to 100,000 times better conductors than ordinary rock and soil, the great effect produced by an orebody is readily appreciated.

As a result of the experience of over a decade and a half a great many refinements and additions have been made in the use of the direct-current method, which now make it applicable to a far greater variety of problems than would be the case were it confined to equipotential observations only. Unfortunately, at the present time the theory behind these newer developments cannot be made public.

Among the geological problems to which direct current is particularly applicable are the following: (a)

study of the trend of beds in tilted formations, lying beneath overburden; (b) general study of concealed anticlinal and synclinal folding; (c) location of faults, their strike and dip; (d) determination of the exact shape and size of a conductive orebody and of the depth to it; (e) use of drill holes in the study of intersected formations (their dip, outcrop, and so forth); and (f) exploration for oil and location of salt domes.

The study of these artificial direct fields has been or is being used successfully in France, Roumania, Spain, Italy, Servia, Poland, Africa, the United States, and Canada.

IN THE Lundberg-Nathorst method, developed about 1918, instead of passing the current between the two distant points, it is passed between two long parallel, bare wires, laid on the surface of the ground a certain distance apart. The equipotential lines between these two "linear electrodes" are straight lines parallel to them. These lines are traced by means of shunting off a portion of the earth current through a telephone. When no sound is heard in the receiver, it means that the two contacts, shunting the current off, are at the same potential. In this as well as in certain applications of the direct current method, the perturbations of the equipotential lines are noted.

Electro-magnetic methods began to attain successful use beginning with Sundberg's work in Sweden in 1921. In these systems a secondary current is caused to flow in a conductive mass, such as an orebody, and the resulting electromagnetic disturbances caused thereby are studied. The current can be caused to flow in one of three ways—inductively by means of closed loops or insulated wire, galvanically by direct transmission through the ground, and capacitively by antennae of bare wires insulated from the ground.

The inductive method only will be considered, as there is no fundamental difference between it and the second method mentioned, and these two have had probably wider application than the capacitive one. A high-tension alternating current is passed through a loop of insulated cable, laid on the ground in a rectangle several hundred feet on a side. The electromagnetic field created by this current will induce secondary currents in any near-by metallic conductor, such as an orebody. The study of the total resultant electromagnetic field is then carried out by means of small coils of wire, moved from place to place, in which this resultant field generates a current. By this means the vertical and horizontal components of the electromagnetic field are determined, the vertical being at a maximum over the center and the horizontal over the edges, of a conductive orebody. A sulphide mass may thus be outlined with considerable accuracy, provided it is not too deeply buried to permit this to be done.

FINALLY, the simplest method of geophysical prospecting is the one known as "spontaneous polarization," in which naturally generated electrical currents are the phenomena studied. This procedure is entirely different from the ones just described, and is the most direct means of utilizing electricity in prospecting for metallic ores.

The phenomenon involved was first discovered in 1830 by Robert W. Fox, who experimented on the copper veins of Cornwall. He noted a marked electrical activity in the neighborhood of the sulphide masses. Professor Schlumberger, while experimenting with his method of direct current in 1912, rediscovered this phenomenon, and developed a technique capable of utilizing it.

Briefly, the chemical action of ground water upon sulphide minerals results in the generation of a weak electrical current, which is usually about one hundred times stronger than the universally observable telluric, or earth currents.

The method depends on a systematic exploration of the ground with the two non-polarizing electrodes and a potentiometer to detect, measure, and note directions of these currents. They usually flow in toward the body at the surface of the ground, and the points into which they seem to be concentrating, called "negative centers," are located. About these points equipotential curves may be drawn (as in the direct-current method) which will outline the horizontal projection of the upper part of the body. Measurements of potentials are made which, when properly mapped, indicate roughly the strength of mineralization, width of body, and depth of overburden. This system of electrical prospecting has been successfully used in Europe, South Africa, Japan, the United States, and Canada.

The method of "spontaneous polarization" exploring is particularly well adapted to mining conditions. The lightness, ruggedness, and simplicity of the apparatus make it easily transportable anywhere, and the rapidity with which ground is covered make it a truly "prospecting" method, to be used where varying thicknesses of overburden hide valuable sulphide ores.

It has not been the purpose of this paper to attempt a comprehensive or thorough discussion of geophysical prospecting. To accomplish this would require a display of formulas calculated to affright all but the most hardened mathematician. The end in view was merely to give a perspective of the subject, comprehensible to a person with ordinary technical information, and to point out its perfectly logical development from pre-existing procedures.

Each method of prospecting has its peculiar uses and limitations, and each is capable of solving many geological problems. Whether or not a given puzzle is solvable by geophysics, and, if it is, then what method is best, are questions to be answered only by the reputable members of a new and fast-growing profession—the geophysicists.

## Cost of Dewatering Simmer Jack Mines

In a paper read before the Empire Mining & Metallurgical Congress recently A. Craib gives the following statement of costs of dewatering the Simmer & Jack Mines:

| | Running | Maintenance | Neutralization |
|---|---|---|---|
| White wages | £1,342 9 5 | £352 5 10 | £130 10 4 |
| Native wages | 125 12 11 | 125 11 7 | 608 1 4 |
| Compound expenses | 63 1 10 | 52 7 0 | 320 0 4 |
| Underground supervision | ... ... ... | ... ... ... | ... ... ... |
| Engineering department expenses | ... ... ... | ... ... ... | ... ... ... |
| Workshops— | | | |
| Carpenters | ... ... ... | ... ... ... | ... ... ... |
| Fitters | ... ... ... | ... ... ... | ... ... ... |
| Blacksmiths | ... ... ... | 1,137 14 11 | 28 0 11 |
| Boilermakers | ... ... ... | ... ... ... | ... ... ... |
| Electricians | ... ... ... | ... ... ... | ... ... ... |
| Electric power expenses | 26,243 16 1 | ... ... ... | ... ... ... |
| Stores | 74 9 4 | 2,062 16 5 | 307 4 0 |
| Lime | ... ... ... | ... ... ... | 4,221 13 2 |
| Assaying | 13 3 0 | ... ... ... | ... ... ... |
| Totals | £27,862 12 7 | £3,730 15 9 | £5,615 10 1 |
| Cost per thousand gallons | 10,547d. | 1.412d. | 2.126d. |

Total cost, £37,208 18s. 5d., = 1s. 2.085d. per thousand gallons.

# *Magnetite Crystals in Sinters*

## *The Sequence of Crystallization*

By G. M. SCHWARTZ
*Department of Geology, University of Minnesota*

RECENTLY I have examined polished surfaces of many iron-ore sinters in co-operation with the work of the Minnesota Mines Experiment Station.[1] Data have accumulated which seem to illustrate the manner of growth of crystals. Similar facts have been observed by the metallographer in the study of metals.[2] In this case the artificial mineral is one of common occurrence in nature and in most cases the result is not unlike the structure of natural magnetites, but with this difference: the cooling is rapid and at places the amount of $Fe_3O_4$ available is limited so that many skeleton crystals are formed.

The sintering process as applied to iron ores was originally introduced in connection with the utilization of blast-furnace flue dust. The principle of the process is to form a porous aggregate from the very fine material which will react favorably in the furnaces. This aggregate is obtained by mixing powdered fuel with the fine dust or ore, wetting and igniting the mass in a forced draft. The fuel burns and the ore clinkers or sinters. The entire process, including cooling, requires about forty minutes. With the introduction of concentration in the iron-ore industry, the process has become increasingly important.

In the case of iron ore the original material may be hematite with more or less limonite, or magnetite, but the sintered product is mainly magnetite. Examination shows that part of the mass has recrystallized and part seems to have crystallized from local molten areas, as it is probable that at least a small area surrounding a center of combustion becomes molten. The powdered fuel causes a great many centers of combustion.

WHEN polished surfaces of the sinters are examined euhedral crystals of magnetite are found, if gangue is abundant, and irregular grains of magnetite if gangue is absent. Where gangue is abundant there was a deficiency of $Fe_3O_4$ at places, and various forms may be observed as shown by Figs. 1 to 5. Figs. 1 and 2 show typical dendritic and skeleton forms. These were arrested at this stage by a lack of material and were prevented from rearrangement by the rapid cooling of the sinter. A nucleus starting at a point grew rapidly in one direction and less rapidly at right angles, thus giving a ladder-like effect shown especially well in Fig. 1. As crystallization progressed, growth tended to connect across from these arms, partially or wholly, filling in solid crystals. Filling in the crystal continued as long as material could migrate. Fig. 4 shows what is obviously a skeleton of an octahedron which had not quite filled in but had completed a network over the entire extent of the crystal. In magnetite it seems characteristic for the branches at right angles to connect across, completing a skeleton with a square cross-section. Thus the original directions of growth become diagonals of a square which as noted above is considered the cross section of an octahedron. Fig. 2 shows several examples of the tendency to connect axes of growth forming square outlines.

When gangue is absent, or nearly so, and there is plenty of material available, euhedral crystals do not form, because of interference, but polyhedral grains are formed, such as are typical of cast metals and most natural magnetite. (See Fig. 6). Such a field may be obtained from almost any massive titaniferous magnetite by etching with HCl. The result in the end, of the process here described, is so similar to natural occurrences that it seems certain that the growth here outlined is that followed in the crystallization of many natural magnetites.

THE mode of development of crystals as described draws attention to the significance of euhedral crystals in ores. Many papers describe the occurrence of euhedral crystals and give varying interpretations. Some euhedral crystals are formed previous to the developing minerals,[3] and it has been stated that they were always earlier. Tolman and Rogers[4] believe that euhedral silicates may replace sulphides and that euhedral magnetite is deposited later than the silicates. Magnetite often forms euhedral crystals in replacing hematite[5]. Many other examples of late euhedral crystals may be found in the literature.

In a sinter it is probable that magnetite and gangue crystallize simultaneously. If there is a sequence, magnetite undoubtedly precedes the gangue.

The following generalizations may be made with regard to euhedral crystals in ores:

Euhedral crystals embedded in other minerals in an ore may be earlier than, contemporaneous with, or later than surrounding minerals.

Earlier crystals will as a rule show corrosion or replacement lacking this, there may be doubt as to relative age. Pyrite is perhaps the most common early mineral in ores. It, of course, often replaces gangue minerals assuming euhedral form.

[1]Aided also by a grant from the research fund of the Graduate School of the University of Minnesota.

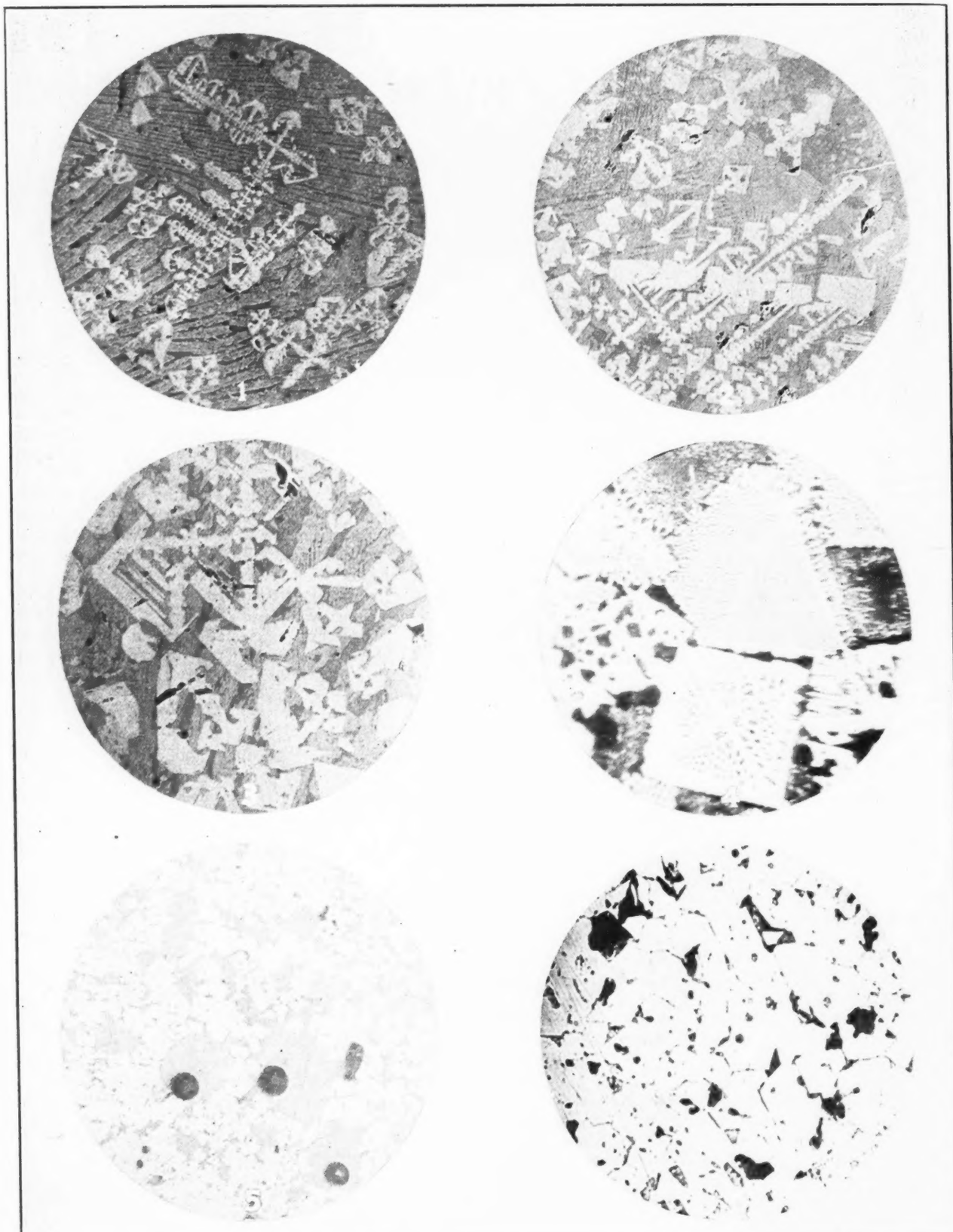
[2]See, for example, Rosenhain, W.: "Introduction to Physical Metallurgy," London, 1914, pp. 61-77. Also Desch, C. H.: "Metallography." London, 1910, pp. 175-193.

[3]See, for example, *Econ. Geol.*, Vol. 16, p. 11, Fig. A.

[4]Tolman, C. F., and Rogers, A. F.: "A Study of the Magmatic Sulfid Ores." Leland Stanford Junior University Publications, 1916. Tolman, C. F.: *Econ. Geol.*, Vol. 12, pp. 379-386, 1917.

[5]Gruner, J. W.: "Paragenesis of the Martite Orebodies and Magnetites of the Mesabi Range." *Econ. Geol.*, Vol. 17, pp. 1-14, 1922. Schwartz, G. M.: "New Ore of the East Mesabi Range." *E. & M. J.*, Vol. 116, pp. 409-422, 1923.

## Micrographs of Magnetite in Iron-Ore Sinters



1. Dendrites of magnetite in gangue. Shows a very incomplete stage of the process. Mag. X 100. 2. Dendrites, skeleton and euhedral crystals of magnetite in gangue. Shows many stages of growth. Rapid cooling and exhaustion of material prevented further growth or rearrangement. Mag. X 100. 3. More nearly complete skeleton crystals of magnetite in gangue. The gangue mineral in Nos. 1, 2 and 3 corresponds closely to hypersthene. Mag. X 200. 4. Completely outlined skeleton crystal of magnetite. Network of magnetite nearly completes crystal. Mag. X 650. 5. Subhedral to euhedral crystals of magnetite in gangue. Conditions and amount of iron available favored formation of complete crystals. Mag. X 200. 6. Polyhedral grains of magnetite. Shape due to interference rather than free growth of crystals as in above. Mag. X 100.

Evidences of contemporaneity are not abundant. Euhedral crystals in a gangue lacking evidences of other relationships are probably contemporaneous. Titaniferous magnetite in gabbro is perhaps the most common example.

Euhedral minerals of later development may be recognized where a persisting mineral is obviously replaced. Blades of hematite, for example, are cut off sharply at the boundary or replacing magnetite crystals.

I noted an interesting comparison of the dendritic forms described above with those shown by Emmons and Laney in the recent report on the Ducktown district.[6] They say regarding the structures, of which several excellent micrographs are shown, "Chalcopyrite and sphalerite exhibit the same kinds of intergrowths that are characteristic of sphalerite and pyrrhotite and in addition there are occasionally found minute crystallites or skeleton crystals of sphalerite in massive chalcopyrite. So far as form is concerned, these crystallites of sphalerite are similar to the dendritic crystallites that develop in certain molten slags, in mattes and alloys as they freeze."

In the Ducktown case it is obvious that only a small amount of sphalerite was available in the small vein and the skeletons lacked material to complete their growth. It is particularly noted by Emmons and Laney that the specimens showing the skeletons came from a small vein of nearly pure chalcopyrite. Elsewhere in the ore sphalerite is often more abundant than chalcopyrite. It may be safely concluded that sphalerite and chalcopyrite, with this relation, are contemporaneous. Some may interpret this relation to mean crystallization from a melt, but this is not necessary and was certainly not true at Ducktown, where igneous rocks except a few small gabbro dikes are found only at a distance of several miles from the mines. In this connection it may be well to emphasize that the crystals described did not grow in a melt. If it did a sinter would not result.

[6]Emmons, E. H., and Laney, F. B.: "Geology and Ore Deposits of the Ducktown Mining District." U. S. Geol. Survey Prof. Paper 139, 1926.

## Bauxite Industry Flourishing in Hungary

HUNGARIAN bauxite exports amounted to only 120 quintals in 1925 and to 721 quintals in 1926, says the U. S. Department of Commerce. Exports of importance began only in the present year with the first shipments to the Lautawerke Co., a German firm. Only 15 metric tons of bauxite ore was exported to Czechoslovakia and 24,007 tons to Germany during the first quarter of 1927.

There are two districts in Hungary in which bauxite deposits are situated—the northern district, situated in the Vertes Mountains, which extends northeast from the southwestern hills of the Vertes almost to the Danube River, and the southern district, in the Bakony Mountains, on the northwest coast of Lake Balaton. It is estimated that the deposits in the two districts contain 200,000,000 metric tons.

Exploitation of the deposits has recently begun in the Vertes Mountains in the vicinity of the village of Gant, in the County of Fejer. In this district 1,200 to 1,400 tons of ore is produced per day by surface mining. Estimated production for 1927 is 250,000 to 300,000 tons. The bulk of the ore produced has been going to Germany, although a small percentage is used in Hungary for experimental purposes. Germany formerly received its bauxite from Istria, but these shipments have stopped, and the German aluminum interests now depend almost entirely on the Hungarian bauxite. The rapid development of the industry in Hungary dates from 1926.

## Unusual Candor?

A new company with a nominal capital of £1,000, was recently registered in London to carry on the business, *inter alia*, of "manipulators of tin and other metals." Presumably ore concentrating is referred to, but the phrase also carries another meaning.

***Working a Tin Face at Mount Bischof, in Northwestern Tasmania***

# *Organic Flotation Reagents*

## *A Brief Explanation of Their Chemical Composition*

By J. C. Williams

When it was customary to refer to the flotation process as "oil flotation," the oils employed were generally classified as "frothers" and "collectors." Frothers included such compounds as the pine oils, particularly steam-distilled pine oil, whereas the term collectors was applied to such compounds as coal tar and the heavy mineral oils. Present-day flotation practice has retained the frothing oils, but the collectors as a class have been largely displaced by certain organic chemicals known as "promoters." This development dates from the introduction of the "alphabet reagents" by the Metals Recovery Co. The first of such reagents to attain widespread use was X-Y mixture, a solution of 60 parts of alpha-naphthylamine in 40 parts of xylidine. A-T mixture was similar, xylidine being replaced by ortho-toluidine. (T-A, now being used, is a solution of thioureas in aniline.) These reagents possess both frothing (slight) and collecting or promoting qualities. They were extensively used in the treatment of copper ores. At present the only use of X-Y is in the Tri-State district, where its peculiar properties are well adapted to the ores and operating conditions there existing. Another of the alphabet reagents was T-T mixture, 20 parts of thiocarbanilide dissolved in 80 parts of ortho-toluidine. It found favor in copper and lead-zinc mills. At present very little is being used in copper work. It seems to be particularly effective in the separation of galena from complex ores, and is being used extensively in the treatment of lead-zinc-iron ores.

The next development of any importance was the introduction of potassium (or sodium) xanthate. It was first used at Anaconda, and in a short time found favor in many flotation plants and for treating many types of ores. It is very effective, even when used in small amounts, is cheap, and has the great advantage of being extremely soluble in water. It is usually used in circuits made alkaline with lime or soda. Alkali xanthates as flotation agents have been patented by Keller and Lewis, the patents having been assigned to the Minerals Separation North American Corporation. Xanthates of the heavy metals such as lead, zinc, and copper seem to be effective flotation agents, although so far as I know they have found no commercial use. They have been patented by Ralph E. Sayre. A reagent which has received attention recently is "Phosphocresylic Acid" or "Aërofloat." It is the reaction product resulting from treating cresylic acid with phosphorus pentasulphide. This compound has been patented by Francis T. Whitworth, and is being made and distributed by the American Cyanamid Co. In addition to these definite well-known chemical compounds there has been extensive use of what are called "sulphurized oils," which are also known as "reconstructed oils." Their base is usually pine oil or creosote oil distilled under reflux condensers with sulphur or sodium sulphide, or similar oil-sulphur mixtures heated under pressure in autoclaves. Coal tar may also be so treated yielding an acceptable reagent.

To obtain a clear idea of the chemical nature of the various organic flotation reagents, it is desirable to consider briefly some phases of organic chemistry.

Organic chemistry is the study of the compounds of carbon. Organic compounds are usually classed in two main divisions. One includes the fatty or aliphatic compounds and the other the aromatic compounds. These two divisions may be regarded as being derived from methane, $CH_4$, and benzene, $C_6H_6$, respectively.

### The Aliphatic Compounds

Methane is one of a series of compounds known as saturated hydrocarbons, so called because its members are saturated with hydrogen. This series has the general formula $C_nH_{2n}+_2$. Examples are methane $CH_4$, ethane $C_2H_6$, propane $C_3H_8$, among others, all compounds having similar chemical properties. It will be noticed that each member differs in composition from the rest by $n.CH_2$. Such a series is called a homologous series. The hydrocarbons $C_nH_{2n}+_2$ are always denoted by the termination "ane."

By the removal of one hydrogen atom from $C_nH_{2n}+_2$ there is obtained a series $C_nH_{2n}+_1$. This series contains what are known as alkyl groups. They are named by changing the suffix "ane" of the corresponding hydrocarbon to "yl": thus, methyl, ethyl, and similar word forms. These alkyls are unobtainable in the free state, but it is often necessary to consider them as definite entities.

If one of the hydrogen atoms of the series $C_nH_{2n}+_2$ is replaced by an OH group, there result the corresponding alcohols of the general formula $C_nH_{2n}+_1OH$. Thus, $CH_3.OH$, methyl alcohol, $C_2H_5.OH$, ethyl alcohol. Where the hydroxyl hydrogen of the alcohols is replaced by a metal, there result compounds known as alkoxides or alcoholates. The best known are sodium methoxide, $CH_3.ONa$, and sodium ethoxide, $C_2H_5.ONa$.

Alcohols react with acids with elimination of water forming esters, as

$$M.OH + H.R = M.R. + HOH$$
(alcohol acid ester)

If one molecule of water is taken from two molecules of alcohol, ethers are formed. They have the general formula $C_nH_{2n}+_1.O.C_nH_{2n}+_1$.

Alcohols and ethers may be regarded as derived from water by the replacement of one or both of its hydrogen atoms by alkyl. If the hydrogen atoms of hydrogen sulphide are similarly replaced there result mercaptans, or thio-ethers, as $C_nH_{2n}+_1.SH$ and $C_nH_{2n}+_1.S.C_{2m}H_{2m}+_1$.

Amines may be regarded as derived from ammonia by

the exchange of hydrogen for alkyl radicals. Nitro compounds contain the group $NO_2$, the nitrogen atom being linked directly to carbon.

Acids: $C_nH_{2n}O_2$. When the group $CH_2OH$ of the primary alcohols is oxidized to COOH a series of acids is formed known as the fatty acids. Acetic acid is an example, $CH_3.COOH$.

Aldehydes and Ketones: $C_nH_{2n}O$. Oxidation of primary and secondary alcohols in which two atoms of hydrogen are eliminated produce respectively aldehydes and ketones. It is seen that an aldehyde is an intermediate product in the oxidation of an alcohol to an acid, as

$$\underset{\text{Primary alcohol}}{C_nH_{2n}+{}_1OH} \longrightarrow \underset{\text{aldehyde}}{C_nH_{2n}O} \longrightarrow \underset{\text{acid}}{C_nH_{2n}O_2}$$

Aldehydes contain the group $-C\begin{matrix}\diagup\!\!\diagup O\\ \diagdown H\end{matrix}$. Ketones contain the carbonyl group, CO, in union with two carbon atoms.

Hydrocarbons $C_nH_{2n-2}$. Acetylene, $C_2H_2$, is the first member of this series.

Monobasic Unsaturated Acids: Oleic acid, $C_{18}H_{34}O_2$, is a member of this series.

Unsaturated Dibasic Acids: Oxalic acid, COOH. COOH, belongs to this group.

Cyanogen Derivatives: These include

Cyanogen, $C_2N_2$
Hydrocyanic acid, HCN
Cyanic acid, HCNO

$$\text{normal}\quad C\begin{matrix}\diagup OH\\ \equiv N\end{matrix} \qquad \text{iso}\quad C\begin{matrix}=NH\\ \diagdown O\end{matrix}$$

Thiocyanic acid, HCNS

Derivatives of Carbonic Acid:

$H_2CO_3$ or $CO(OH)_2$. $C\begin{matrix}\diagup OH\\ =O\\ \diagdown OH\end{matrix}$.

Urea $C\begin{matrix}\diagup NH_2\\ =O\\ \diagdown NH_2\end{matrix}$ This is formed by the addition of ammonia to iso-cyanic acid:

$$C\begin{matrix}=NH\\ \diagdown O\end{matrix} + NH_3 = C\begin{matrix}\diagup NH_2\\ =O\\ \diagdown NH_2\end{matrix}$$

Carbamic acid: $C\begin{matrix}\diagup NH_2\\ =O\\ \diagdown OH\end{matrix}$, which is the semi-amide of carbonic acid, is not known in the free state. Ammonium carbamate is formed by the union of dry carbon dioxide with dry ammonia:

$$CO_2 + NH_3 = C\begin{matrix}\diagup NH_2\\ =O\\ \diagdown OH\end{matrix}; + NH_3 = C\begin{matrix}\diagup NH_2\\ =O\\ \diagdown OHNH_3\end{matrix}$$

Thio derivatives of carbonic acid:
Carbon disulphide, $CS_2$
Tri-thiocarbonates, $BaCS_3$

Xanthate, $CS_2 + KOC_2H_5 = C\begin{matrix}\diagup OC_2H_5\\ =S\\ \diagdown SK\end{matrix}$

Thiourea: $CS(NH_2)_2$. Ammonium iso-thiocyanate yields thiourea in a manner analagous to the formation of urea from ammonium isocyanate. Alkyl derivatives of thiourea result from addition of ammonia or amines the mustard oils (iso-thiocyanic esters $C\begin{matrix}\diagup\!\!\diagup N.R\\ \diagdown\!\!\diagdown S\end{matrix}$), the reaction being similar to the formation of alkyl-substituted ureas from isocyanic esters. The constitution of thiourea is expressed by the formula $CS(NH_2)_2$, being similar to that of urea. Derivatives of thiourea are known, however, which point to the existence of a tautomeric form: $C\begin{matrix}\diagup NH_2\\ -SH\\ \diagdown\!\!\diagdown NH\end{matrix}$

## Aromatic Compounds

The second great division of organic compounds embraces that class of substances known as the aromatic compounds, which may be considered as derived from benzene, $C_6H_6$. The molecule of benezene contains a closed chain of six carbon atoms each attached to a hydrogen atom. It may be represented by a hexagon, with a CH molecule at each of its corners, and it is suggested that the reader draw such a hexagon on a piece of paper to make clear the further explanations.

The six hydrogen atoms of benzene are of equal value. The different di-substitution products are distinguished by the prefixes ortho, meta, and para. The position of the substituents is conveniently denoted by numbers. In the benzene hexagon, No. 1 position is considered to be at the upper apex of the hexagon, and the numerical positions proceed clockwise to No. 6 at the upper left-hand corner. When there is a substitution of the H at adjoining corners, such as 1 and 2, or 2 and 3, the substitution products are called ortho compounds; when at such positions as 1 and 3, or 2 and 4, meta compounds; and when at opposite corners, as 1 and 4, or 2 and 5, or 3 and 6, para compounds.

There is another class of compounds having condensed rings or two closed chains with two carbon atoms common to each. A type of these substances is naphthalene, $C_{10}H_8$, containing two of the benzene hexagons with one common side. Assuming these hexagons stand side by side, the upper apex of the right-hand hexagon is called No. 1 position. Proceeding clockwise, as before, No. 4 position is at the bottom of the right-hand hexagon, No. 5 is at the bottom of the left-hand hexagon, No. 8 at the top of the left-hand hexagon, and Nos. 9 and 10 the common points.

Two series of mono-substituted-products are known: those in which the hydrogen at 1, 4, 5, or 8 has been replaced are called alpha-derivatives; and when the hydrogen is substituted at 2, 3, 6, or 7, the products are termed beta-derivatives.

*X-Y Mixture:* This is a solution of 60 parts of alpha-naphthylamine in 40 parts of xylidine. At ordinary temperatures it is a freely flowing liquid, but at low temperatures the alpha-naphthylamine crystallizes from the solution. During cold weather, therefore, it is necessary to warm the solution. The disgusting odor of this mixture is due to alpha-naphthylamine. This reagent has been extremely useful for floating zinc in the Tri-State District, being almost foolproof there. One of the difficulties of milling in this district arises from the nature of the water used, which is practically all surface water, impounded. After a heavy rain when organic matter or soluble salts are washed into the ponds, X-Y seems less affected by changed conditions than other reagents.

The chemical constitution of alpha-naphthylamine may be expressed by drawing the twin benzene hexagons rep-

resenting naphthalene, and substituting an $NH_2$ group for the H in the No. 1 position.

Alpha-naphthylamine is thus a condensed ring or naphthalene compound with an amine group.

Xylidine is a mono-amino derivative of xylene, which is a homolog of benzene. If the reader will take pencil and paper and draw a few hexagons, or benzene rings, with a CH group at each corner, the following changes may be made to show some of the benzene derivatives: If $CH_3$ takes the place of H at one corner, we have toluene. If two $CH_3$ groups displace the H's at two corners, we have xylene, which may be either ortho (if the substitution is made at adjoining corners) or meta or para, as already explained. If an $NH_2$ group be substituted for one of the H atoms, making $C_6H_5NH_2$, we have aniline. If the H at one corner is removed and an $NH_2$ group substituted, and $CH_3$ substituted for the H at an adjoining corner, we have ortho-toluidine, $C_6H_4CH_3NH_2$. Now, taking the ortho-toluidine hexagon, and substituting another $CH_3$ for the H in the No. 3 position, we have xylidine, the flotation reagent, or $C_6H_3NH_2\ (CH_3)_2$.

The so-called X-Y mixture has been selling for 45c. a pound, and from 0.05 to 0.10 of a pound is usually used per ton of ore.

T-T Mixture: This is a solution of 20 parts of thio-carbanilide in 80 parts of ortho-toluidine. This mixture has to be kept warm to prevent the thio-carbanilide from crystallizing out. The composition of ortho-toluidine has already been described. Thio-carbanilide, or diphenyl-thiourea, may be expressed thus: $\begin{matrix} \diagup NH.C_6H_5 \\ C-SH \\ \diagdown N.C_6H_5 \end{matrix}$.

T-T mixture sells for about 25c. to 30c. a pound.

Thio-carbanilide is prepared by heating aniline with carbon disulphide. There are a number of thio-ureas derived from compounds similar to aniline, most of which are good flotation agents. In T-T mixture, the function of ortho-toluidine seems to be almost entirely as a solvent. It has, however, a mild frothing ability and is extremely useful where a gentle brittle froth is desired.

Xanthate: The potassium salt of xanthic acid is formed by the action of potassium ethoxide on carbon disulphide. Or the salt may be easily prepared by allowing molecular equivalents of potassium hydroxide, ethyl alcohol, and carbon disulphide to react.

$$KOH + C_2H_5OH + CS_2 \rightarrow \begin{matrix} \diagup OC_2H_5 \\ CS \\ \diagdown SK \end{matrix} + H_2O.$$

The reaction is exothermic and the mixture should be kept cool to prevent decomposition. The sodium salt is made in a similar manner. Heavy metal xanthates are prepared by adding a solution of an alkali xanthate to a metallic solution. Xanthates may also be prepared by using other alcohols—e.g., amyl alcohol (fusel oil). Xanthates sell for from 15c. to 20c. a pound.

Aërofloat (Phospho-cresylic Acid): This reagent is prepared by treating cresylic acid with phosphorus pentasulphide. This yields a mixture which, by decomposition and polymerization, contains a number of complex thiocompounds, probably with a large amount of sulphydryl present as thio cresol.

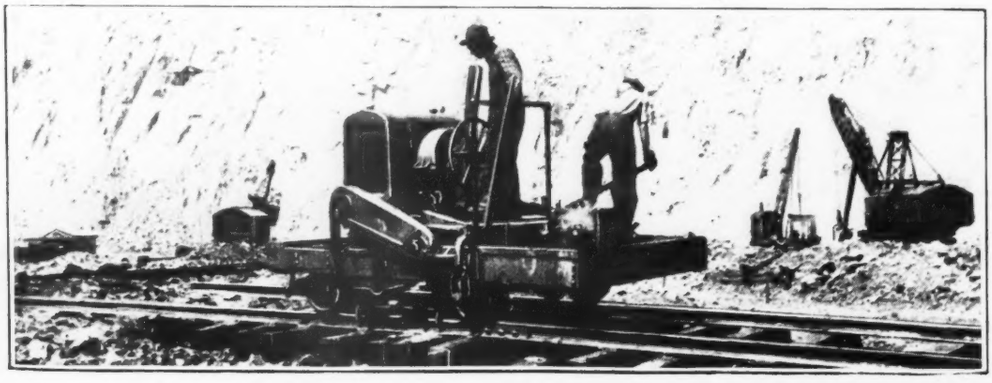
To gain a better idea of the composition of this reagent, take pencil and paper and draw six more hexagons in two rows of three each. Benzene, of course, has the CH at each corner. If an OH group is substituted for the H at one corner, we have phenol or the well-known carbolic acid. If an SH group is substituted, instead of the OH, we have thio-phenol. In like manner, in the hexagons in the second row, put a $CH_3$ in place of the H in the No. 1 position of the first hexagon; this gives toluene, as shown earlier in this paper. Now, with a $CH_3$ in No. 1 position, add an OH in No. 4 position and we have para-cresol. Or if SH is used instead of OH, we have para-thio-cresol. Cresylic acid is a mixture of ortho, meta, and para cresols. The reagent sells for about 16c. a pound.

It is interesting to note that of the four reagents discussed three contain an —SH group. The other contains nitrogen in the form of an amine group. Compounds containing both nitrogen and sulphur are known which are extremely effective flotation promoters.

Most of the organic compounds useful as promoters are also effective as accelerators in the vulcanization of rubber. In fact, the most powerful promoter with which I am familiar, a nitrogen-sulphur compound, is also one of the most efficient accelerators. Why this is so is not clear. There is no generally accepted explanation of the action either of flotation promoters or of rubber accelerators, and it is difficult satisfactorily to demonstrate an analogy between the two.

As there is no generally accepted theory to account for the effect of flotation agents, their development has necessarily been by the cut-and-try method. This has resulted in a few positive lines of action and has given a better understanding of what is desired for certain effects. As is always the case, practice is ahead of theory. But the gap is being steadily closed, and it is not too much to expect that it will not be long before theories of certain phases of flotation will have been proved or disproved.

**Track Shifting Machine in United Verde Open Pit**



# USEFUL OPERATING IDEAS

## Hoisting From Shallow Shafts

By G. A. Joslin

THE hoisting rig shown in Fig. 1 was invented and developed by a native foreman in the Chilean nitrate fields. It is useful in sinking to moderate depths with a small power hoist. The rig combines a headframe which supports the hoisting sheave and a track and trolley for moving sheave and bucket to the dumping position. The track is a steel rail. Its weight depends upon its span and the weight of the loaded bucket. It is supported at one end by a tripod centered over the shaft and at the other and elevated end by a back brace. Tripod and back brace are made of 4-in. pipe. The upper ends of the pipes are bent at an angle of 30 deg., flattened, punched with one bolt hole each, and bolted to the rail. Riding on the rail on solid steel wheels, 3 to 4 in. in diameter, is the trolley upon which the sheave is suspended. The trolley frame is made of two $\frac{1}{4}$-in. iron plates shaped to hang free of the web of the rail and held together by the axles of the trolley wheels, the shaft of the sheave, and spacing bolts between the rail and the sheave shaft. The shaft of the sheave extends to each side of the trolley frame, and on these extensions, secured by cotter pins, is hung a swinging clevised hook used to engage a ring attached to the swivel on the bale of the bucket. At the top of the trolley frame is another clevis, which clasps the upturned end of the rail and acts as a locking hook. The hoisting cable passes over an idler pulley, attached to the rail near the back brace, thence down to the hoist.

The trolley is placed in hoisting position (see Fig. 2) by locking the top hook over the upturned end of the rail that projects out beyond the top of the tripod. With tension on the hoist rope the sheave is now secure. When the loaded bucket is hoisted the top man engages the ring of the bucket swivel with the hook suspended from the sheave. The hoistman then slackens the hoist rope, the weight of the bucket is taken on the sheave hook, and as there is no tension on the locking hook this is now released by pulling a rope attached to its overhanging end. When the lock hook is lifted the hoistman "hoists," pulling trolley, sheave, and bucket up the track to the dumping position. When the bucket is dumped the hoist clutch is released, the trolley runs down the rail by gravity, and the lock hook slides over the end of the rail and locks. The hoistman lifts the bucket enough to free the swivel ring from the sheave hook, which is now pulled out of the way, and the bucket is lowered.

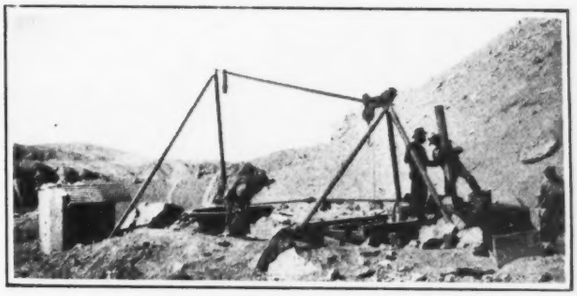


*Fig. 1—Hoisting rig for shallow shafts*

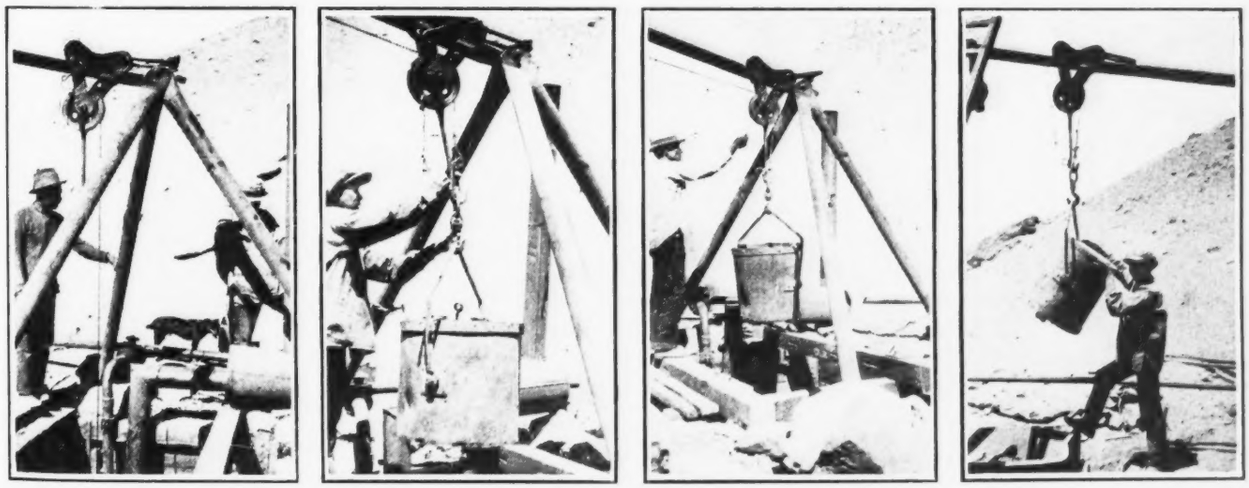


*Fig. 2—Details of operating hoisting rig: 1, Hoisting; 2, inserting sheave hook in swivel ring; 3, releasing lock hook; 4, dumping*

Using this rig in Chile, where labor was cheap and the speed of dumping a factor, a top man was employed. The rig can be modified, however, so that the top man is unnecessary. By securing a ball just above the bucket swivel, in place of the ring, and replacing the sheave hook with a split socket to engage the ball, then, by

means of two wires to the trolley—one to the socket hook, the other to the lock hook—the hoistman can perform all operations, except dumping, from his seat at the hoist.

The rig is simple to operate, can be built cheaply and

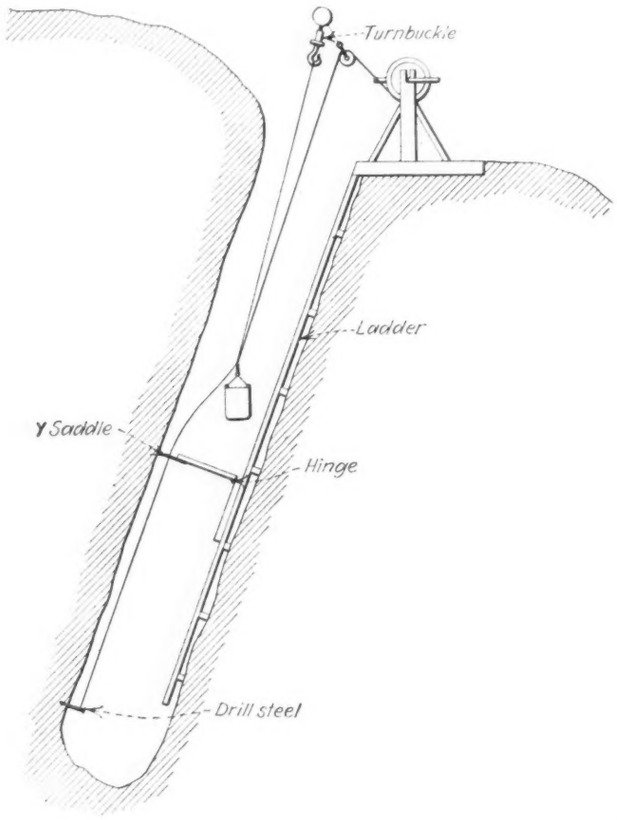



*Fig. 3—Hoisting rig for inclined shaft*

quickly, is readily transported, and its use eliminates the necessity for doors or similar provisions for the safety of men under the bucket in the shaft. If the hoistman overwinds he will lift the tripod and collapse the whole rig, but the bucket will land clear of the shaft. The rig can be used for vertical or inclined shafts. The pipe tripod may be also used in sinking test pits by hand. A pulley is hung from the center of the tripod and a double length of rope. The extra rope hangs down the test pit so that the shoveler in the pit and the man at the top can both pull on the hoisting rope.

In sinking inclined shafts when hand hoisting is required the scheme illustrated in Fig. 3 works well. A track rope, a small steel cable, or a well-greased $\frac{3}{16}$- or $\frac{1}{2}$-in. manila rope, is anchored to a steel driven in the "hanging wall" a few feet above the bottom of the shaft and tied to a turnbuckle at the top. A "scissor" ring, attached to the bale of the bucket, slips over the track rope. When hoisted, the bucket is freed by slipping the ring from the track rope, and dumped. When the length of the track rope becomes so great that the turnbuckle can no longer keep it taut, a hinged "Y" saddle is placed in the shaft at the point where the bucket, on the free track rope, will just pass. The saddle is made of $\frac{1}{4}$-in. round iron, shaped to a "Y" and fastened on a plank hinged to the ladder. From the end of a strap-iron on the plank, ropes lead to the bottom and to the top of the shaft so that the miners may lower the saddle to pass the bucket and raise it when the bucket has passed.

The rig has been used successfully to depths of 200 ft. in shafts inclined 70 deg. by using two saddles. It has the advantage of saving timber and labor over the usual method of placing wooden guides on the footwall of the shaft. In Chile, where the method was developed and used, greater speed in sinking was obtained than when using timber guides. Five-gallon oil cans were used as buckets. Although holding very little material, it was proved, for conditions obtaining there, that more material per shift was hoisted than when using larger and heavier buckets.

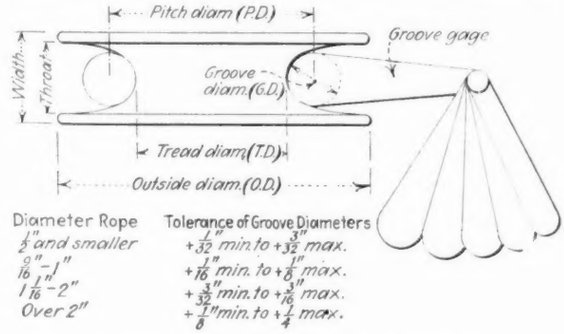
# Do the Sheaves Fit the Hoisting Rope?

By Walter Voigtlander
*Rope Engineer, American Cable Co.*

PERHAPS NO SINGLE ELEMENT is more detrimental to wire rope than an improperly fitted sheave. A pinching sheave, for instance, will do more damage to a wire rope in an hour than a properly grooved sheave could in a week or more. A sheave with too soft a tread will increase abrasion and grinding action to an extent that will cause premature breaking of the outer wires and loss of rope strength. Because of these facts, and because sheaves are cheaper than good wire rope, it is necessary to examine sheave and auxiliary equipment when the service received from a rope is not all that it should be.

Engineers and operators sometimes overlook the fact that by the time it becomes necessary to install a new rope the old sheave will have become worn to such an extent that it will cause serious loss to the service of the new rope. Invariably excessive wear to the outer wires can be traced to the abrasive action of worn or too soft sheave treads. When installing a new rope, therefore, it is desirable to gage both the rope and the grooves of all sheaves and drums. If the groove diameter of any sheave is less than the actual callipered rope diameter, decreased service is bound to result.

One of the simplest and most accurate methods for gaging sheave treads is through the use of a groove gage as indicated by the accompanying illustration. If the device is used with care, and if the tolerances given in the accompanying table (which have been worked out in accordance with long experience) are followed, longer and more satisfactory rope service may be expected. At the time such attention is given sheaves it is well, also, to check up on alignment. Defective alignment will cause considerable wear to both rope and sheaves. Particularly in high-speed work is it necessary to maintain proper alignment of all equipment and to balance all sheaves.




*Groove gage and groove tolerances*

# NEWS OF THE WEEK

## Summary

*STUDY of the beneficiation possibilities of the phosphate bearing materials of Florida is undertaken at the Southern Station of the U. S. Bureau of Mines.*

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*Strike situation continues unchanged at mines in the Etzatlan district, Jalisco, Mexico; main point at issue appears to be a conflict between the "Red" and "White" wings of organized labor.*

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*Cabinet minister of the Union of South Africa states diamond marketing agencies should have no cause for alarm in present conditions of the industry in the Union.*

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*Recent work by technicians of the U. S. Bureau of Mines indicates that a minimum amount of air is required in the flotation of non-metallic minerals.*

* * *

*United States Co. of New Jersey announces that a Colorado company will be formed to operate consolidated vanadium properties.*

* * *

*Mining companies of the Michigan copper district are vitally interested in proposed reduction in freight rates on coal from Southern fields.*

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*Broken Hill Proprietary and Block 14 mines at Broken Hill, Australia, are to be shut down if prices do not improve soon.*

* * *

*Recent successful operations encourage development of lead properties in the Moon Creek section of the Coeur d'Alene district.*

* * *

*Colonel Charles A. Lindbergh goes underground at the Leonard mine of the Anaconda Copper Mining Co., at Butte.*

* * *

*Ahumada Lead Co. develops silver-lead claims in the Garibaldi Mountains, near Los Lamentos, Chihuahua, Mexico.*

* * *

*Placer operations are resumed on the Salmon River, Idaho.*

# Demands of Labor Held Responsible for Closing of Mount Morgan

### *Chairman of Directors States Combination of Short Hours, High Wages and Superior Working Conditions Makes Profitable Production Impossible*

By Peter G. Tait
*Special Melbourne Correspondent*

SHORT hours, high wages, and superior working conditions, such as has been thought wise to concede in Australia, have made the profitable production of copper impossible at Mount Morgan, with prices that have been ruling in the world's market." This sentence by J. M. Niall, chairman of directors of the Mount Morgan Gold Mining Co. in his address to shareholders, sums up the situation which led to the decision to cease operations at this famous mine and for the company to be liquidated. In the last six years the loss on mining, treatment, and realization of metals has amounted to £557,617. Against this there has been income from investments of £342,044, leaving a net loss for the period of £215,573. Over the same time, which has not been one of the greatest production, the products of the mine realized £2,444,642. Here is a mine with ore reserves of 8,000,000 tons, containing gross metal values of nearly £16,000,000, which is to be thrown idle because of economic conditions. For the next few months operations will be confined to the realization of ore in hand and cleaning up. A proposal has been made by the townsfolk, employees, and others interested to form a co-operative company, but in the face of all facts and the very exhaustive enquiries by experts, it seems hopeless to expect any permanent success. On the basis of the reports, Colin Fraser has calculated that if the capital required to install the new open-cut mining plant and reverberatory furnaces were expended on the basis that it should be returned in twelve years and 10 per cent paid to shareholders, copper would have to stand at a price of £107 per ton, which is £47 more than the figure taken by E. E. Barker in his estimates.

#### History of Operations

The Mount Morgan gold mine was discovered in 1882 and worked by a Rockhampton syndicate until June, 1886, when the Mount Morgan Gold Mining Co. was formed. The original plant was a stamp battery, and so long as returns of 25 oz. per ton were obtainable, everything was satisfactory. Later the gold was recovered by chlorination. Ultimately the copper zone was entered, and this led to the introduction of blast furnaces. It is of interest to set down, in brief, a few statistics. In its career the tonnage of ore treated by the company amounted to 8,488,500 tons. The recovery of gold was 5,066,200 oz. and of copper 123,780 tons. The company paid £9,329,166 in dividends, the last distribution having been made in May, 1920.

#### Present Action of Mount Lyell Strikers Shortsighted

The action of the engineers at Queenstown in going on strike in an attempt to compel the Mount Lyell company to agree to the introduction of the 44-hour week, from which award they were temporarily exempted, is a short-sighted policy. As a consequence hundreds of men are out of work, and are clamoring for government relief as there is no other employment offering on the west coast of Tasmania. Why is it that men of the superior artisan class refuse to face facts? They ought to know the present condition of the copper-mining industry in Australia. They have before them the result of similar tactics at Mount Morgan, but are apparently indifferent, not only to the company's welfare but to their own. The company is endeavoring by the expenditure of capital and the introduction of improved methods to reduce the cost of production, and yet abide by awards of the commonwealth arbitration court in regard to increased wages and better conditions for the employees. If in spite of this the employees, or a section of them, decide to ignore the arbitration court because it does not give them just what they ask, an impossible situation arises. The court has now issued an order against the union and its members, which renders each employee on strike liable to fine and imprisonment for breaking the rulings contained in the agreement.

## New Company Enters Jerome District of Arizona

*United Verde Copper Improves System of Ventilation—Barbara Claims Taken Over by Goetz & Co.*

THE Verde Contact Co., recently incorporated in Nevada with a capital of $3,000,000 is planning to take over a group of properties adjoining the United Verde Copper Co. on the south. The properties which will be developed by this company lie along the porphyry contact in which the deposits of the United Verde Extension and United Verde occur. In the course of 1,200 ft. of development work done by an earlier company a fairly good contact and some mineralization was disclosed. The holdings also adjoin the Gadsden, Green Monster, and Jerome Del Monte properties.

The United Verde Copper Co. is making improvements to the ventilation system of its Jerome mine at a cost of $200,000. A fan having a capacity of 250,000 cu.ft. of air per minute has been installed on the 1,000-ft. level in a concrete housing. A concrete lined air raise 900 ft. long and 14 ft. square in cross section forms the intake. Fresh air is drawn through the raise, then forced to the bottom of the mine and distributed upward through the workings. The exhaust air is collected at every fifth level and passed up an independent outlet. All inlet and discharging chambers are of fireproof construction throughout.

J. J. Goetz & Co., of New York City, has taken over the Barbara claims in the Copper Mountain district, south of Mayer, which were formerly operated by the United Eastern Co. under an option. The new company is known as the Barbara Mountain Mining Co., it will also develop the Eva and Emporia claims in the Senator district. The company is planning to build a mill in the Senator district in the near future.

The Blue Monster Copper Co., whose property is located along the south fault line, about twelve miles in a southerly direction from Jerome, is said to warrant consistent exploration work, as a result of the investigations of several geologists and engineers who have lately reported very favorably on the property. Recent development has strengthened the early hope of the company as to the presence of large deposits of ore, and it is believed that sufficient work has now been accomplished to warrant the development of the property on a large scale.

During the past few weeks, 700 men have been laid off at the three mines of the Cananea Consolidated Copper Co. at Cananea, Sonora, Mexico. This is the result of the recent ore strike which opened up the largest high-grade orebody ever found in the Cananea district. Formerly, the payroll covered extensive mining operations on several bodies of low-grade ore. The new discovery allows the company to cut down the payroll and still operate the mines with even greater earning capacity and a large output of copper than formerly.

Rapid progress has been made in the mining and development at the Ahumada Mining Co.'s property in the Los Lamentos district, south of El Paso. This continued until water was struck. At first makeshifts were used, and it was believed that the small amount of water could be readily handled without elaborate equipment. However, after a number of attempts were made, it was found that preparations had to be made to handle a substantial flow before the deeper workings could be opened up. The additions to the power plant have been made and the new pumping equipment is already on the ground. It is believed that within another month, the new pumping equipment will be in operation and the deeper exploration work can then be prosecuted.

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## Lindbergh Goes Underground at Leonard Mine

Colonel Charles A. Lindbergh recently visited Butte and was taken underground at the Leonard mine of the Anaconda Copper Mining Co. Upon completion of the trip the Colonel stated "That is one of the most unique experiences I ever had." As the guest of J. Carlos Ryan of the Anaconda company, Colonel Lindbergh and party were taken on a three days' hunting and fishing trip among the lakes and mountains in the northwestern part of Montana.

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## Diamond Industry Well Protected, Says F. W. Beyers

Assurance that diamond marketing interests should have no cause for alarm in conditions of the South African diamond industry was expressed by Hon. F. W. Beyers, K. C., Minister of Mines and Commerce in the Union of South Africa, at a luncheon on Sept. 7, in New York City, given in his honor by Eric H. Louw, Commissioner for the Union of South Africa in the United States and Canada.

Mr. Beyers stated that the Union of South Africa derives in revenue twenty per cent of the value of all diamonds produced. Present laws and pending legislation, he said, adequately protect the industry and this source of revenue accruing to the Union.

In speaking of the economic development of his country, the Minister said that new laws requiring the grading of base minerals had been adopted and others would be enacted to make South African exports of these commodities comply with American requirements.

Guests at the luncheon included Sir Harry Armstrong, British Consul General; G. Parker, chairman of the Importers' and Exporters' Association; and A. J. Barnuad, of the Bureau of Foreign and Domestic Commerce.

## Colorado Management for Vanadium Properties

*Many Camps Active—New Wellington Plant Operating—Three Shifts Used at Royal Tiger*

THE United States Co. of New Jersey, which recently acquired large vanadium interests in Colorado and Utah, plans to erect a modern reduction plant for vanadium ore at Newcastle, Rifle, or Denver, at a cost of about $250,000. Already, over $200,000 has been invested in vanadium properties and it is planned to purchase more territory as soon as suitable sites are found. The United States company plans to form a Colorado company to operate the vanadium interests as soon as preliminary details are completed.

The new flotation mill of the Wellington Mines Leasing Co., at Breckenridge, has been put into operation and is doing excellent work in making high-grade zinc and lead concentrates. H. L. Tedrow, manager of the mine, says the zinc product is of a higher grade than was made at the old plant and that the lead product is an almost pure lead sulphide. The mill is handling 125 tons daily but this will be built up to 150 tons shortly. Additions have been made to the underground force and production from the lower levels of the mine will be increased to keep the mill in steady operation.

The New El Paso Mines, Inc., have opened up new orebodies in the Plutocrat and El Paso mines at Cripple Creek, according to Superintendent Woodward. A combination gasoline hoist and compressor unit has been installed on the Plutocrat property. John Gilbin and Herman Carlso working on the old Free Coinage property at Cripple Creek have opened up an ore shoot proven for a length of 20 ft. and averaging several feet in width. The ore was encountered in the sinking of a winze below the floor level. The present work indicates that the top of a blind ore shoot was touched and that considerable ore may lie below the tenth level at this point. The Mary McKinney mine in the Anaconda district has been thoroughly examined and will probably be reopened. John Pringle, former lessee of the Portland No. 1 at Victor, has the mine under lease. The property is already equipped with electrical machinery as it was just closed early in 1926.

Three shifts of mill employees are operating the concentration mill of the Royal Tiger Mines Co. at the Tiger camp near Breckenridge. Better values in sulphide ores are responsible for the increased activity. It is also reported from Breckenridge that the Witchazel group of thirteen lode mining claims on North Star Mountain have been sold to Eastern interests for $50,000. An extensive body of tantalite ore has been found on the ranch of R. P. Morehouse near Guffey, according to M. J. McCarthy, state mining inspector who reported the find. The tantalite is accompanied by large deposits of sheet

mica of exceptional grade. The tantalite ore averages 50 per cent tantalic oxide. The Truelove group of mining claims located fifteen miles southwest of Antonito is again being exhaustively tested. About $30,000 will be expended in making the necessary tests according to the officials of the company. The Wood Mountain group of mines, near Boulder, has been purchased by J. G. Clark, Boulder County mine operator, it was announced recently. This group of mines has been a big producer of good gold ore, although no spectacular finds have ever been made in the group. The amount of the sale was not announced. Reclamation Metal Mines Co., of Cripple Creek, owning and operating the Black Diamond property through the Sangre de Cristo tunnel, on Tenderfoot hill, has encountered low-grade ore. It is expected that the grade will improve with depth. A 400 ft. sinking program and a thorough test of the region immediately surrounding the Black Diamond is proposed.

The Gold King mine in La Plata County has made several large shipments to the Golden Cycle mill at Colorado Springs recently. The mine is more active than in recent years, and $200,000 has just been spent in the building of a mile of tramway and other development work on the property. At the present time over 100 men are employed. Superintendent Fred Jones of the Portland mine, in the Cripple Creek district, announces that good values have been obtained in the main drift of the No. 1 vein on the thirty-first level of the mine. The West Gold Mining Co., operating near Idaho Springs, has been employing two shifts on their property in the Chicago Creek district. The main mine development is confined to the opening of new ore bodies and the blocking out of known ore shoots. The excavations for the new mill buildings are now nearing completion and the 250-ton unit of the milling plant will be started soon.

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## Placer Operations Resumed on Salmon River, Idaho

AFTER forty years of nearly complete inactivity, operations on the sand and gravel bars that line Salmon River in central Idaho are being resumed. Two interests, the Irbis Placer Co., and the Ruby Gold Development Co., have started projects along the river. The Ruby company has installed a hydro-electric plant near Lucile and the Irbis is operating at Butcher bar.

The bars along the Salmon have been mined for generations. Many boulders and uneven topography, however, make the preliminary testing of these placer deposits difficult. Water supply is ample and with the aid of hydro-electric equipment deposits can be worked which were previously inaccessible. Climatic conditions are favorable for continuous operations.

History has brought out many theories about Salmon River gold, many of which have already been tested by individual miners. Some felt the best opportunities were in pocket hunting along abandoned portions of the river bed. Occasionally a pocket containing large gold nuggets was found, but rich pockets were rare, and, in the end, operations of this sort were abandoned.

Colors can be panned on practically every sand bar along the river, even in the wind blown material, and the fact that the main stream and its tributaries pass through highly mineralized areas keeps alive the dream that the stream holds vast riches hidden beneath its swift-moving current. The Irbis company has spent about $50,000 in hydraulic equipment preparatory to conducting its big-scale test of the possibilities of the sands. The gravel bed now being explored averages 265 ft. in depth and 1,200 ft. in width. The Ruby company has 100 acres of land with the placer deposit averaging 60 ft. in depth.

*The Aspen mining camp in Colorado*

# Prolonged Life Indicated for Aspen Camp

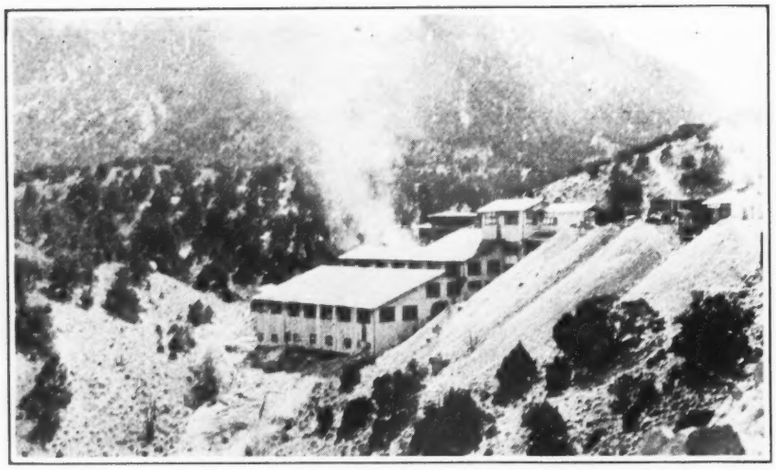
### *Further Prospecting Vital—Current Daily Output 100 Tons of Low-Grade Ore—Smuggler Leasing Co. Principal Producer*

PRESENT production at the Aspen, Colo., mining camp is about 100 tons daily of low-grade silver-lead ore containing a high percentage of lime, which makes the ore desirable as a flux. The producer receives 15c. per unit for the lime, the ore content of which is frequently as high as 40 to 50 per cent. Silver is present to the extent of only a few ounces and the lead rarely exceeds 5 per cent. The Smuggler Leasing Co. is the principal producer in the district. This company has a daily output of about 80 tons, most of which is from the Durant tunnel, on Aspen Mountain. Seventy-five men, nearly all of whom are leasers, are employed at the Durant workings.

The total value of the output of the Aspen district from 1880 to 1926 inclusive, as estimated from trustworthy sources, is $103,000,000 in silver, lead, and zinc. Annual production attained a maximum in 1892, when the value of the output reached nearly $8,000,000. The next year, however, it declined to $4,500,000, and by 1908 had fallen below $1,000,000. It fluctuated around this figure, with some increase during the war years, until 1921. Production then steadily declined, but 1927 shows strong indications of a revival of mining in the district.

It has been stated that the ore-bearing formations of Aspen, Gilman, Red Cliff, and Leadville are identical and that in the three districts last named rich ore deposits have been found along contacts other than the contact developed in the Aspen district. Hence, it is believed that prospecting these other contacts along the crosscutting faults and fissures which have produced ore, or showed strong mineralization, on the previously developed contact at Aspen, will disclose new ore deposits, the development of which should prolong the life of the camp and perhaps revive interest in district mining operations.

In the right background of the accompanying photograph of Aspen are the Smuggler mine and Smuggler Mountain; Red Mountain, Hunter Creek, and Cowenhoven tunnel are in the left background.



*Bellehelen property, Bellehelen district, Nye County, Nev.*

## Clifford Gold Mines Acquires Bellehelen Property

Control of the Bellehelen gold-silver property in the Bellehelen district of Nye County, Nev., was recently acquired by the Clifford Gold Mines Co. The mine has been a periodic producer over a period of thirty years. The mill, which is shown in the accompanying photograph, was built in 1922. Cyanide practice is used. Operating power is obtained from a Diesel engine-electric plant on the property. Ore from the property is augmented with some hauled by truck from the Clifford mine fifteen miles away. Precipitates are refined at the West End plant in Tonopah.

## Dickens Consolidated Mines Will Build New Mill

*In Moon Creek Section of Coeur d'Alene District—Callahan Company Sinks Shaft*

THE Dickens Consolidated Mines Co., of Wallace, Idaho, will build a flotation mill of 200 tons capacity, planned with the view to later increasing that capacity. This announcement follows the carrying out of a development program undertaken about a year and a half ago. The shaft has been sunk to a depth of 400 ft. or to what is known as the 500 level, and on the last two levels there has been a marked improvement in the ore as well as more favorable geological conditions. Down to the 300 level the ore is both lead and zinc in about equal parts and in a Prichard slate formation. At the 400 level the formation had changed to Revett quartzite, the ore shoot was larger and practically all lead, zinc having decreased to about 3 per cent. On the 500 level the quartzite continued, zinc disappeared altogether and the trifling gold value usually associated with Coeur d'Alene lead ore increased.

The Dickens mine is situated on Moon Creek, a section of the Coeur d'Alene district which is classified by the geological survey as Prichard slate and therefore unfavorable to lead deposits. Efforts to develop the property have been made intermittently for many years, but the slate formation and the presence of zinc, until comparatively recent years worthless in the Coeur d'Alenes, were handicaps that could not be overcome. The development of the flotation process, making it possible to separate and recover both the lead and zinc, made the Dickens a more attractive proposition. About two years ago the present company took over the property and its success has encouraged the development of other properties in the Moon creek section, on the theory that deeper development will disclose the same favorable change from slate to quartzite.

Callahan Zinc-Lead Co., which owns the Galena mine near Wallace, is preparing to sink the main shaft 600 ft. deeper to the 2000 ft. point. A station will be cut at the 1,400 level and a sinking hoist will be installed, this plan being adopted in order to avoid as far as possible interference with the operation of the hoist in the shaft above. Another important development feature at the Galena is a drift east on the 600 level which is expected to result in finding another ore shoot which will greatly increase the output from the mine. Galena is equipped with a highly efficient flotation mill of 150 tons capacity, and, if the development plans now being carried out prove successful as expected in greatly increasing the ore reserves, the capacity of the mill will be doubled.

## Civil Service Announces Examinations

The U. S. Civil Service Commission announces open competitive examinations for the positions of Junior Engineer and Junior Mining Engineer.

Applications for the examinations must be on file with the Civil Service Commission at Washington, D. C., not later than Oct. 1. Full information concerning the examinations may be obtained from the U. S. Civil Service Commission, Washington, D. C.

## Develop Rich Orebody at East Pacific Property

Montana-Idaho Mines Corporation is planning to sink to the No. 8 level of the East Pacific property in order to develop the rich orebodies exposed on the level above. The company, which has taken over the East Pacific, Kleinschmidt and January groups near Winston, Mont., has been making regular shipments of high-grade silver-lead-zinc-gold ores from the East Pacific property to the East Helena smelter of the American Smelting & Refining Co. Lately, shipments have been averaging $30 in gold per ton, which is unusual for the district. The company recently completed its own hydro-electric plant, and production is being increased by the company's mill on the Kleinschmidt property which was recently put into operation on ore from this tract.

*East Pacific property, near Winston, Mont., of the Montana-Idaho Mines Corporation*

# Toronto Letter

*By Our Special Correspondent for Northern Ontario*

## Ontario's Gold Production Increases in 1927—Grade Decreases

TORONTO, SEPT. 8—A recent report of the Ontario Bureau of Mines showing the gold production for the first six months of 1927, shows a total recovery of $15,824,821 as compared with $15,588,986 for the corresponding period of 1926. The tonnage treated was 2,071,816 tons as compared with 1,793,366 tons in 1926. The average grade of $7.65 compared with $8.72 in 1926. The increase in total value is largely accounted for by the Lake Shore which produced $1,570,438 in the first half of this year as compared with $1,226,717 in 1926. During the period the Porcupine mines treated 1,724,574 as compared with 1,548,170 tons in 1926 and recovered $11,613,643 as compared with $12,156,447, the decrease being largely accounted for by lower grade ore treated by Hollinger. The Kirkland Lake mines treated 347,342 tons as compared with 235,196 for the corresponding period of 1926 and recovered $4,179,633 as compared with $3,388,645 for the first half of 1926.

OFFICIALS of the Harvie Mining Exploration Co. announce that a strike of major importance has been made on their Rouyn properties. On the 125-ft. level of the No. 1 shaft, drifting to the south opened up two parallel orebodies, the first 15 ft. wide and the second 16 ft. wide, both carrying high-grade zinc and copper ore. In addition, diamond drills have cut these two orebodies at the 200 ft. level, but no announcement of the width at this point has as yet been made.

The Lake Shore Mines of Kirkland Lake, which has recently been treating approximately 675 tons per day, will probably be handling between 750 and 800 tons daily, within a couple of months. Work was started recently on sinking the new shaft on the north shore of the lake which will be used for men and materials, the older south shaft being used for ore.

Teck-Hughes Gold Mines has just started drifting on the 14 and 15 levels. The work of drifting on the 16, 17, 18 and 19 levels is to be started within a short time. The second unit of the first half of the new mill, bringing the new mill tonnage up to 300 tons and the total mill tonnage to 550 tons, is operating smoothly.

Wright-Hargreaves Mines produced about $225,000 in August, the highest month in the history of the property the grade of ore being between $12 and $13. A new tube mill is being installed and the mill capacity will shortly be 650 tons on the present grade of ore. Work west on the north vein, on the 1250, 1375 and 1500-ft. levels continues to give good results. Drifting has reached another fault and will be continued southward along this fault to pick up the continuation of the ore. Drifting east on the south vein at the 1500 ft. level, has advanced about 200 feet in ore of good grade.

The Wabigoon-Contact Bay Gold Mines at Dryden, in northwestern Ontario, has let a diamond drill contract to drill its property, the work to start some time this month. Considerable trenching and stripping done on the property has yielded quite encouraging results.

## Michigan Copper Companies Consider Coal Rates

*Southern Shippers Offer Reduction—Fire Destroys Sand Loading Plant at Point Mills*

MINING companies of the Michigan copper district, which receive their coal supplies by boat, are vitally interested in the rate situation as it affects lake cargo coal from the great producing fields in Virginia, West Virginia, Kentucky and Tennessee. Shippers from the Southern fields have announced a 20c. reduction, and the matter now is in the hands of the Interstate Commerce Commission. Eleven operators' associations argue in a statement filed with the commission that consumers of lake cargo coal, not only in the Northwest but in the New England, Southern and Central states would suffer with the coal producers and users in the Southern coal fields should the commission interfere with the voluntary reduction. Coal traffic to the Northwest, the statement says, moves during the season of open navigation on the Lakes when demands of other markets are less active than in colder seasons. By keeping the mines operating, the cost for fuel in other seasons for New England, the South and Central States is decreased. The voluntary 20c. reduction would effect a saving of many thousands of dollars annually for the mining companies of the Michigan copper district, particularly in the case of Calumet & Hecla Consolidated, which uses a large tonnage annually.

The sand loading plant on the old Franklin copper sands at Point Mills, owned by the Asphalt Block Pavement Co. was destroyed by fire recently with a loss of $10,000. The plant has been in operation since 1911, shipping between 10,000 and 15,000 tons of sand each season for use in manufacture of paving blocks. It is probable the plant will be rebuilt.

The vein which Mayflower-Old Colony is opening on the 1,750-ft. crosscut continues narrow. It contains some shot copper. The opening will be continued in hope the lode will widen.

No. 16 shaft opened on the Osceola lode by Calumet & Hecla Consolidated is producing. Four shafts on this vein now are hoisting rock.

# Washington Letter

BY PAUL WOOTON
*Special Correspondent*

## Study of Florida Phosphate Ores Made at Bureau's Southern Station

WASHINGTON, SEPT. 10—A study of the beneficiation possibilities of the phosphate bearing materials of Florida has been undertaken at the Bureau of Mines' southern station. The phosphate producers, because of the difficulties of competing abroad with the Moroccan product, are in serious straits. The study has as its object the development of economies in the handling of the raw material. Flotation tests have not given encouraging results. The insoluble matter is chiefly quartz. No difficulty is found in securing a 70 per cent recovery of phosphate rock with some 10 per cent of the insolubles.

Recent work on the flotation of nonmetallics convinces Bureau specialists that they require a minimum amount of air. Excessive froth removes the flotation reagent before it has a chance to play its part. For that reason better work apparently results from the use of machines of the M-S type than with other machines which admit larger amounts of air. In addition, the southern station has begun a study of certain Mississippi and Alabama bauxites. A new study of coal washing problems also has been launched.

MORE classification of lead ores than is usual in southeast Missouri is desirable, a Bureau of Mines report states. Studies looking to better milling practice have been underway for some months. Similar studies are in progress in the Tri-state zinc district. The operators there are following closely the float-and-sink tests being made by Bureau engineers. On account of that interest a display board has been prepared on which are mounted complete fractionations of a representative mill feed of the district.

Two new microscopic methods for the quantitative analysis of feldspar which seem suitable for commercial plant control work have been developed by the Bureau of Standards. The new methods involve quantitative analyzation of the optical properties, contrasted with the usual chemical analysis made of ore bearing minerals.

Cancellation of interstate commodity rates on fluxing limestone is not justified, the Interstate Commerce Commission finds in a recent decision. The Commission found, however, that there is much to justify the application of commodity rates which are not in excess of the rates on ground limestone. As a result it was specified in the decision that new schedules along that line might be filed without being prejudiced by the decision.

# Mexico City Letter

By W. L. Vail
*Special Correspondent*

## Strike Situation at Mines in District of Etzatlan, Jalisco, Unchanged

Mexico City, Sept. 1—The situation at the Amparo, Piedra Bola, and Mazata mines, district of Etzatlan, State of Jalisco, where a strike of Reds has been on for several weeks, had not materially changed on the first of September. The main point at issue now appears to be the conflict between two wings of organized labor, the Reds (Communists) and the Whites (Moderates). Serious trouble apparently dates from last March, when the Reds refused to abide by a presidential decree transferring the authority to arbitrate on labor disputes from local authorities to the Department of Labor, Commerce and Industry, in the City of Mexico. The Reds armed, took possession of the camps, and forced the members of the White organization to suspend labor against their will. Some minor outrages against White workers, and acts of sabotage also, are reported by local correspondents near the scene of the troubles, though no violence is known to have been offered foreigners who have, in most instances, left the camps and are residing in the near-by villages of Etzatlan, Ahualuco, San Marcos, and in Guadalajara, awaiting the cessation of outlawry and the return of normalcy.

Notwithstanding repeated statements that federal troops had been ordered to the disturbed district to protect foreigners and restore order, no troops had arrived there up to Sept. 1, although on this date another telegram was sent from Guadalajara stating that fifty soldiers were entraining for Amparo, but with instructions to maintain a neutral attitude between the strikers and mine owners. The failure to send troops, in face of repeated statements to the contrary, may be the result of a belief on the part of the federal government that the situation is not so serious as it is made out to be in press despatches and in official reports from local American authorities to their home government.

ALL statements from Etzatlan regarding the origin of the strike are conflicting. James Howard, manager of the Amparo company, is quoted as stating that "work is paralyzed at the Amparo mine because the ore is too low grade for profitable working under present conditions and that the same situation exists at Piedra Bola, where the company has lost half a million pesos in the last few months." The Mazata mine, however, is declared to be in bonanza and the owners are anxious to resume work.

The Mexican Corporation at Fresnillo is maintaining operations in spite of low price of metals and low-grade ores, and owing in great measure to large tonnages treated daily at the cyanide and flotation plants—approximately 3,000 tons. La Noria mines, at Sombrerete, property of the Cia. Inversiones del Oro, is mining and milling about 400 tons per day. Operations have been maintained fairly successful in spite of difficulties attending the new enterprise—namely, isolation and heavy cost of power. The Amatlan Mining Co., district of Chalchuihuites, has closed down owing to frequent bandit raids and lack of protection. All other operations in the districts mentioned are curtailed and meager, owing mostly to low prices and heavy cost of power, which is generated at each plant. As a result of general adverse conditions few new denouncements are being made and no new money is coming into the mining industry in this state.

IT IS said that a new strike has been made in Chihuahua, on a mountain called El Perdita, in the Garibaldi Mountains, 10 miles north of Los Lamentos camp. The strike was made by D. Bruce Smith, former superintendent of the Erupcion and Ahumada lead mines, while making a mineral survey for the company. The report states that the Ahumada Lead Co. has denounced more than 500 claims and that a considerable force of men has been put to work on exploration. Charles A. Dobbel, company superintendent, is in charge of the exploration work.

In Zacatecas, the Cia. Internacional Minera, a subsidiary company of the Union Corporation, London, has closed down all operations at Bilbao, Santa Ana, and La Fe. The company had been milling and mining about 500 tons daily. The reason given for closing was the low price of metals. Peñoles is still operating at Veta Grande and the smelter at Guadalupe, but on account of loss of the La Fe concentrates, may be compelled to suspend operations. Lessees of the Bote-Pittsburg and Veta-Grande-Pittsburg promise a continuance of operation for some time, notwithstanding the low price of metals and the low values of ores treated. J. C. Archibald, general manager for these properties has made a splendid showing having had long experience on "starvation ores." It is stated that the decline in prices is costing these particular properties approximately 30,000 pesos a month.

According to an official statement from the Department of Mines, the number of mining concessions granted this year is only about 10 per cent of the number granted in 1926. The falling off is credited to the new regulations, which are claimed by mining men to be over-exacting, and by government officials to be entirely fair.

Professor Ramon Mena, in charge of the archæological department of the national museum, has just issued an interesting brochure on the subject of jade. The book contains descriptions of more than 500 separate jade objects taken from ruins in Mexico, with ample historical descriptions of each.

# London Letter

By W. A. Doman
*Special Correspondent*

## Suspension of Operations Probable at Two Broken Hill Properties

London, Aug. 30—Base-metal mining companies have had a shock these last few days. The continuous weakness in the prices of copper, lead, and zinc have begun to make capitalists and investors think. They are now beginning to argue that holding shares in companies mining these metals is more or less gambling in metals, and they did not set out to gamble. There has been much heartburning—also finger burning—for some time, and a kind of knock-out blow was given on Friday last when cablegrams were received from Melbourne stating that owing to the trend of social legislation and the low prices of lead and zinc it would become necessary to close down the Broken Hill Proprietary mine, and the Broken Hill Proprietary Block 14, if metal prices failed to improve within the next three or four weeks. It is more economical to cease operations than to win metals. This announcement, in the language of the market, has made Broken Hill shares "sick." Of course the closing-down hint does not apply to all the mines, but apparently only to the two above mentioned. These are the properties that have the smallest ore reserves, and certainly not the highest metal content.

IT WAS known that the Broken Hill Proprietary was making little out of its mine, and that the cessation of operations was only a matter of time. Also that, as the Block 14 ore is treated at the Broken Hill Proprietary Co.'s works, Block 14 would also have to shut down if its bigger brother failed to work at a profit. Broken Hill Proprietary itself has for long been less of a mining undertaking than a great iron and steel industry at Newcastle, N.S.W., and it is from the last-named industry that the bulk of its profits are derived. It is interesting to recall that, when the Broken Hill Proprietary originally acquired its property it retained, as it thought, the richest part of the deposit. But events have proved otherwise, and the extension companies have fared better. Not alone have the shares of Broken Hill mines suffered from the statement cabled from Melbourne, other lead-zinc shares being forced down on the market with them.

Attempts are being made to revive the mining industry in the Barberton district of the Transvaal, it is said. Since the days of the old De Kaap, and the original Sheba, the quantity of gold produced has not been large. As Barberton does not appear to appeal to the big finance corporations little capital is at present being subscribed to test what are claimed to be new discoveries.

# Situation at the Mines

## *Limited Curtailment Continues Among Non-Ferrous Metal Producers—General Conditions Remain Unchanged*

By H. D. Keiser
*Assistant Editor*

UNCERTAINTY in the non-ferrous metal market on the part of producers was reflected by a continued limited curtailment during August in most of the mining districts. General confidence in the situation was evident, however, in the extensive development programs underway in many sections and in a tendency, in some instances, to increase production slightly. The decline in lead prices the last half of the month, following the earlier advances, although not materially affecting production, caused some apprehension regarding the future.

### Copper

In the Michigan copper district, monthly production is at the approximate rate of 14,200,00 lb. of refined copper. Of this amount, Calumet & Hecla Consolidated and its subsidiary, Isle Royale, are producing about 10,000,000 lb. Quincy output has been cut by the recent fire in No. 2 shaft, leaving only one producing unit until repairs in No. 2 are completed. Labor appears to be quite plentiful in the district, with all mines well supplied. Copper shipments by boat have been heavy throughout the season, and considerable metal has been moved from the district by rail.

Despite the upward trend in the price of copper, or perhaps to aid it, there is a general curtailment at a number of the mines in Arizona. Ray ore production is down to about 7,500 tons a day, and Inspiration is treating between 12,000 and 14,000 tons daily. The leaching plant at Inspiration is operating at capacity, but the output of the large concentrator has been reduced. Magma is still on a 2,500,000 lb. per month basis. An extensive development program is still under way, shafts being sunk from the 2,550 to the 2,800-ft. point, where the new level will be opened up in the next year or two. The new operating shaft, which started about eighteen months ago, has now attained a depth of 2,000 ft.

### Lead and Zinc

A tendency toward a gradually increased output and a decrease in the net unsold stocks characterized the month of August in the Joplin-Miami district. Total concentrate production for the first week of the month was 15,060 tons, whereas toward the close of the month weekly production exceeded 16,000 tons. Net unsold stocks, which at the beginning of the month amounted to 32,081 tons, decreased 8,709 tons to 23,372 tons. The total number of mills operating rose from 128 to 136. For the week ending Aug. 27, production of zinc concentrates amounted to 14,521 tons, of which 1,044 tons was high-grade ore, and 1,402 tons was produced by tailing mills. Output of lead concentrates for the week was 1,934 tons; of the 136 mills operating, thirty were treating tailings.

The advance in the price of lead in July, which reached 6.75c. on Aug. 3, produced a decided air of optimism in the Coeur d'Alene district. The change proved to be short-lived, for the decline in the price since Aug. 16 has produced a feeling of uncertainty regarding the future of the lead market. However, this uncertainty did not affect August production materially, the chief producers, Bunker Hill, Federal, Hecla and Gold Hunter, maintaining their usual output, as did the smaller producers and those conducting leasing operations, the latter having become quite an important factor in the Coeur d'Alene district. Zinc shipments are practically limited to the Morning and Constitution mines, both of which have contracts with the Anaconda company. Other zinc properties have suspended shipments on account of inability to sell their product. This situation will probably not be changed until the completion of the Sullivan electrolytic zinc plant, under construction, which will provide a local market. In spite of uncertainty in the metal market, much new development work is being carried on in various parts of the district; one new mill, that of the Cedar Creek Mining & Development Co., is under construction, and it is expected that the Dickens Consolidated Mines Co. will start construction at an early date. The Bunker Hill smelter is handling the usual tonnage, operating two furnaces.

### Gold and Silver

Conditions in the Tonopah district of Nevada during August continued unchanged with the month's production valued at $150,000, and no important developments taking place. Operations in the Divide district yielded $10,000, and a larger production is expected for September, mainly on the part of leasers working the Brougher and Tonopah Divide mines. An estimated production of $35,000 is reported for the Gold Circle district. Interest in the Manhattan district is active; White Caps mine is shipping fifty tons per day and reports important developments on the 1,120 level. Leasers treating Goldfield Consolidated tailings produced $30,000 in August. Rand Mountain Mining Co. reports a new find in a winze from the 800 level.

New finds in the Aztec and Ben Harrison divisions of the old Tom Reed property at Oatman, Ariz., have aroused interest all over the state. The recent action of the United Verde Copper Co., in taking over the Oatman Eureka mines on a vein system parallel to the Tom Reed, has also stimulated activity in that district. The latest report of a high-grade gold vein discovery in one of the leases on the Bevis Divide-Comstock Silver property, north of Kingman, has added to the interest.

### Lead-Silver

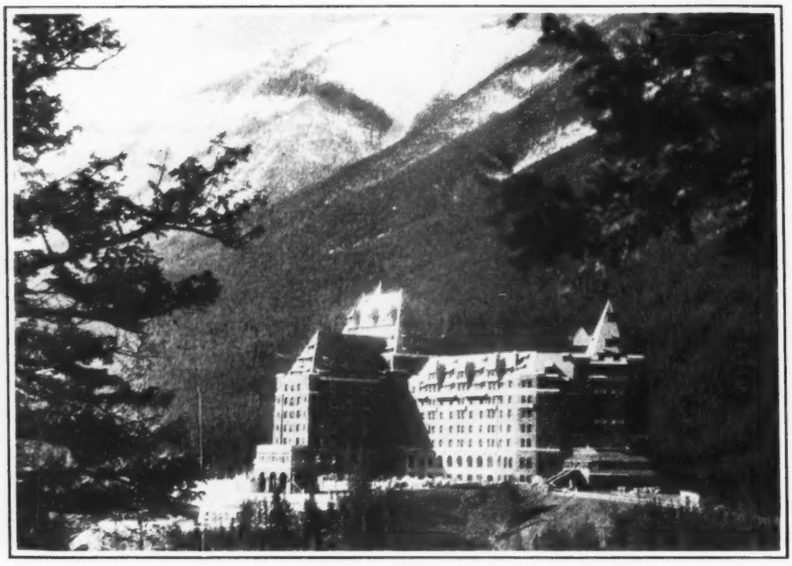
Production at the lead-silver properties in Utah fell slightly toward the close of August, although curtailment did not appear to exist to any material extent. Park City, Bingham and Tintic shipments were all lower the last week of the month. Much attention is being centered in the Ophir district which has been inactive for several years. Exploration under way in the district has for its objective the development of the Ophir foundation in the faulted areas below the surface deposits mined in the past.

The new Phelps Dodge lead smelter at Douglas, Ariz., was blown in on Aug. 18. This plant will handle lead ores from the concentrator in Bisbee, the Copper Queen and Shattuck-Denn mines, and other lead shippers in the southern portion of the state; the Humboldt plant, which is being remodeled to handle complex ores, will handle shipments from the central and northern portions of Arizona.

### Iron

The Great Lakes fleet moved 8,775,990 tons of iron ore from the Lake Superior region during the month of August, bringing the total for the season to Sept. 1 to 35,156,495 tons. This is a decrease of 452,657 tons for the comparable period of 1926. Two mines on the Marquette range, the Rolling Mill of the C. K. Quinn Co. and the Mary Charlotte of the Marquette Ore Co. have been closed because of lack of ore sales, and some of the mines on the Menominee range have reduced the working time from six to five days per week. Stockpiles are large at some of the underground properties and it is feared that some of the other producers will be forced to suspend operations.

Demand for iron ore at lower lake ports appears to be decreasing. The Hill Annex mine of Jones & Laughlin Co. had its quota for the season cut another 100,000 tons and its washing plant is now operating five days per week instead of six. Republic Iron & Steel Co. shut down the Kinney mine on Sept. 6. Pumps were removed from the Deane mine on Sept. 1 by M. A. Hanna Co., as the property is considered worked out. Shipments at the rate of 5,000 tons per day are being made from the Wade mine at Kinney; operations were started at the property on Aug. 17 following a shut down of four years.



*Banff Springs Hotel*

# In Canada with the British Empire Mining Congress

By A. B. Parsons
*Associate Editor*

Banff, Alberta, Sept. 6.—Wherever Nature has put together trees and rocks and water and sky she has made a picture. But in some places it seems that she must have put more heart into her work than in others; and the result has been something of surpassing magnificence. One of these places is Banff, in the Rocky Mountains of Alberta. Any account of the Empire Mining Congress that pretended to approach completeness ought to contain some description of Banff and the surrounding country. However, on the ground that it is better not to attempt something that one cannot do passably well, this correspondent will simply say that he has read and heard much concerning, and seen many pictures depicting, the marvels of Banff, the Banff Springs hotel, and the mountain scenery in the vicinity; and that the reality far surpasses all the rest. In this view he is supported by many members of the Congress; and this, in spite of the fact that it has been raining since our arrival and clouds shroud the peaks. If the scenery is grander in the sunshine, or in the moonlight, it would be even harder to describe. If you have not already seen Banff, and the opportunity comes your way, don't turn opportunity aside!

Since leaving Porcupine last Thursday the only mining that the Congress has seen was in the lignite coal fields of Estevan in Saskatchewan, where about 400,000 tons of high moisture coal is mined annually, from a 10-ft. seam about 100 ft. below the surface. The only point of interest to metal miners, perhaps, is the method of marketing. Only a limited quantity can be sold; accordingly the production is allocated between the different mines, the output is pooled, and sold at the fixed price of $2.10 per ton on the cars at the mines. They must and do compete with coal from other fields, but they avoid a disastrous competition between each other, and as a consequence all are making a fair profit.

### Underground at Kirkland Lake

I shall now go back to Kirkland Lake where the chronological account stopped last week. During the first half of 1927 the district produced gold to the value of $4,180,000, practically all of it from four mines; Lake Shore, Teck-Hughes, Wright-Hargreaves, and Kirkland Lake Gold. The average recovery per ton was slightly over $12, but this was brought down by some of the smaller properties. The capacity of the treatment plants is now greater, and will be increased still further during the second half of this year. Lake Shore can now mill 700 tons per day and Wright-Hargreaves will be up to that capacity very soon. Teck-Hughes, with the completion of the second section of a new 600-ton plant, will be prepared to handle 850 tons. The veins are wide and easily mined by shrinkage stoping. More than a hundred members of the party went underground in one or more mines.

Perhaps the most interesting feature of the camp is the work being done in an effort to improve the extraction which is low on account of the presence of gold-carrying sulphides and tellurides, and perhaps other socalled "refractory" constituents in the ore. At the Wright-Hargreaves it is proposed to treat the mill tailings by flotation in McIntosh and K & K machines after killing the lime and cyanide with soda ash and copper sulphate. The concentrate may be leached with bromo-cyanide, or as an alternative may be shipped to the new smelter at Rouyn. Flotation has been experimented with at the Lake Shore and Teck-Hughes, but the program has not been carried as far as at the Wright-Hargreaves. It is not impossible that the final solution will be grinding in water, flotation of the refractory minerals for separate treatment, and cyanidation of the tailing from the flotation cells.

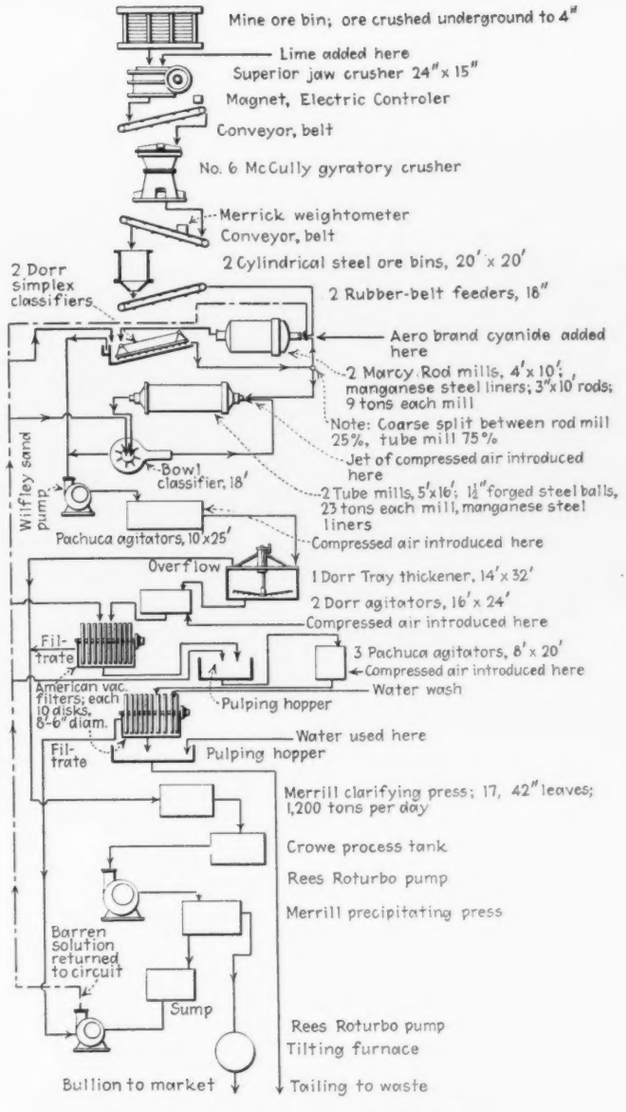
Among the men who extended hospitality to the visitors were W. M. Sixt, of Kirkland Lake Gold; Harry Oakes, largest owner of the Lake Shore and E. B. Knapp, manager; D. L. H. Forbes, manager of the Teck-Hughes; and J. E. Grant, manager of the Wright-Hargreaves.

### Latest Milling Methods in Use at Teck-Hughes Plant

The new 300-ton section of the Teck-Hughes plant is an expression of the newest ideas in construction and treatment in the district, except for some variation in the plans for overcoming the problem of obtaining a satisfactory extraction from the refractory portions of the ore. The accompanying diagrammatic flow sheet shows the more important pieces of equipment and the course of the ore and solutions through

*Automobile road near Banff*

the plant. A few comments will help make clear the scheme of treatment. Fine grinding and thorough agitation and aeration are depended upon to recover the gold from the refractory constituents. In the old plant sodium peroxide


Mine ore bin; ore crushed underground to 4"
Lime added here
Superior jaw crusher 24" x 15"
Magnet, Electric Controler
Conveyor, belt
No. 6 McCully gyratory crusher
Merrick weightometer
Conveyor, belt
2 Cylindrical steel ore bins, 20' x 20'
2 Dorr simplex classifiers
2 Rubber-belt feeders, 18"
Aero brand cyanide added here
2 Marcy Rod mills, 4' x 10'; manganese steel liners; 3"x10' rods; 9 tons each mill
Note: Coarse split between rod mill 25%, tube mill 75%
Jet of compressed air introduced here
Bowl classifier, 18'
Wilfley sand pump
2 Tube mills, 5'x16'; 1½" forged steel balls, 23 tons each mill, manganese steel liners
Pachuca agitators, 10'x25'
Compressed air introduced here
Overflow
1 Dorr Tray thickener, 14' x 32'
2 Dorr agitators, 16' x 24'
Compressed air introduced here
Fil-trate
3 Pachuca agitators, 8' x 20'
Compressed air introduced here
Water wash
American vac. filters; each 10 disks, 8'-6" diam.
Pulping hopper
Water used here
Fil-trate
Pulping hopper
Merrill clarifying press; 17, 42" leaves; 1,200 tons per day
Crowe process tank
Rees Roturbo pump
Merrill precipitating press
Barren solution returned to circuit
Sump
Rees Roturbo pump
Tilting furnace
Bullion to market
Tailing to waste

*Flow sheet of the Teck-Hughes mill*

was used to activate the solutions but this is being eliminated in the new treatment. To the end that the solutions will be saturated as thoroughly as possible with oxygen a jet of compressed air is introduced into the pulp in the tube mill and four auxiliary pipes feed air into the four segments of the bottom of the Dorr agitator, these last being in addition to the air required for the regular lifts. A rather novel feature is the interposition of the series of four Pachuca tanks between the bowl classifier and the primary thickener. The purpose is to obtain as much dissolving of the gold as possible early in the treatment. The solution is vivified so that a good proportion of the recovery is effected in the primary thickener, the overflow from which is much richer in gold than it otherwise would be.

Splitting of the coarse product from the simplex classifier was not intended in the first place, but it developed that the tube mill was slightly overloaded; accordingly one-quarter, or thereabouts, of the sand is returned to the rod mill. Some classification is effected in the bowl classifier, whereby a larger proportion of the refractory particles are returned to the tube mill. As a consequence, whereas 96 per cent of the bowl overflow will pass 200 mesh, a larger proportion of the refractory than of the siliceous particles has been ground to very fine size.

An interesting point is the substitution of the Roturbo centrifugal pump for the usual triplex plunger pump to force the pregnant solution through the precipitating presses. To prevent air from getting into the solution the glands of the pump are served with a small vacuum line. About four tons of solution per ton of ore milled is precipitated. Double filtration with an intermediate pulping with barren solution, as indicated on the flow sheet, is used in practically all of the newer plants in Ontario. Countercurrent decantation has been discarded except where the equipment was installed some years ago.

Power consumption is approximately 15 kw.-hr. per ton of ore mined. The plant is erected on a mill site that is nearly level. Reinforced concrete and structural steel are used throughout and the entire floor is concreted, with drainage to a single sump. The few line shafts needed to operate the thickeners, agitators, and other small units are supplied with ball-bearing boxes. Slime and solution pumps are, without exception, of the centrifugal type, either Rees or Wilfley, all direct connected to motors. The rod and tube mills are driven through speed reducers without belts. For these notes I am indebted to the mill superintendent, H. N. Read; and they are published through the courtesy of Mr. Forbes.

### Timmins Properties Visited

At 4:30 p.m. the Congress left Kirkland Lake for Timmins, where the members were the guests of the mining companies at a ball which to quote the *Porcupine Advance* was "the most perfectly planned and biggest event of its kind ever held in the North." The next day was devoted to visits to the mines and mills of the district. The Hollinger, of course, attracts the biggest crowds, but thanks to the presence of many buses and automobiles it was quite possible to see several of the properties, and many took advantage of the opportunity. The Hollinger management asked visitors not to question the guides who took them underground so that many went away without satisfying their curiosity on some points. However, everyone was welcome to look, and the splendid shaft equipment, the underground crushing stations, and the haulage arrangements, as well as the mill and cyanide plant were inspected and admired. A. F. Brigham, Hollinger's manager, was at the office to greet visitors.

The new McIntyre shaft also was a center of interest. Harry Kee, the superintendent in charge of sinking, was on hand to give as much information as anyone wanted. An interested visitor was William T. Anderson, formerly of South Africa, who declared that the entire undertaking improved upon the most recent practice on the Rand. Richard Ennis, manager of the McIntyre, and James Denny, mill superintendent, showed a large number around the plant and sent several parties underground.

Robert Dye, manager of the Vipond, entertained a number of guests, and various parties took trips to the more distant properties. During the first half of 1927 the Porcupine district, with eight mines contributing, produced gold to the value of $12,156,000 with an average recovery of about $6.75 per ton. Hollinger, incidentally, is now crushing close to 6,100 tons of ore per day, though the understood objective is 8,000 tons.

### Recent Mining Developments in Manitoba

A technical session at Winnipeg was presided over by R. C. Wallace, who has lately been appointed Commissioner of Mines for Manitoba. At this, and at a civic luncheon in honor of the delegates at noon, some idea was gained of the recent developments in mining in the province and of the hopes of establishing an industry comparable with that

*Left to right—H. C. Woolmer, London; W. E. Harris, London; E. C. Bloomfield, Siberia; R. E. Palmer, London; G. F. Braddock, Toronto; L. Gilchrist, Toronto; J. A. L. Henderson, London; H. McMillen, mine captain at the Keeley mine*

**About to Go Underground at the Keeley Mine**

of the provinces farther east. Mr. Wallace drew attention to the fact that geological conditions that favor the finding of ore in Ontario and Quebec are to be found likewise in Manitoba. He noted the occurrence of chalcopyrite, anchorite, tellurides, and arsenopyrite in association with gold ores; and compared the copper-zinc sulphides of the Flin Flon property with similar deposits in Quebec. At the Flin Flon, by the way, a 50-ton concentrator has been in operation for some months making a separation by flotation to give a copper concentrate, a zinc concentrate, and a heavy iron tailing. The tailing is to be cyanided for the recovery of the precious metals contained.

### Airplane Trip to Long Lake

Another scene of development is the Central Manitoba gold area, which was visited by twenty Congress delegates who flew in by airplane from Hudson and Minaki. These parties flew 165 miles to Long Lake, whence they walked to the Kitchener mine of the Central Manitoba Mines, Ltd., and to the Eldorado mine. They then flew 45 miles to the power generating station of the Manitoba Power Co., at Great Falls on the Winnipeg River. The return journey to Winnipeg was made by motor car the following day. The party flying from Hudson met heavy winds and storms which delayed it somewhat, but the flyers were all enthusiastic about the trip and the mines that they saw.

The following men made the journey and thereby entered the hall of fame:

From Hudson: S. M. Bell, England; R. M. C. Briggs, England; John A. McWilliams, England; D. Wyley-King, England; R. Craib, South Africa; W. T. Knowles, England; W. Cochran-Carr, England; and G. V. Hobson, India.

From Manaki: Jules Delruelle, Belgium; P. M. Bussey, South Africa; W. Van Leckwyck, Belgium; M. H. Pearce, England; D. H. Hopper, England; C. St. Claire Parsons, Canada; K. V. Cunliffe, South Africa; F. S. Platten, England; John McLeish, Canada; G. A. Watermeyer, South Africa; H. C. Woolmer England; and J. M. Cairns, England.

### Another Official Banquet

An official banquet—the third that has been labeled official on the program—was held on Saturday night at the Royal Alexandra Hotel. John L. Agnew, president of the Canadian Institute of Mining and Metallurgy, who has been with the Congress from the opening day at Montreal, presided, and had unusual success in curbing the pertinacity of the speakers, possibly by setting them an excellent example of brevity. John Bracken, Premier of Manitoba; Sir A. E. Kitson, of the Gold Coast; R. E. Palmer, of Rio Tinto; and Sir William Furse, director of the Imperial Institute of London, were on the program. A visit to old Fort Gary was the only set feature of Sunday's program, but golf and tennis drew many devotees. The visit to Estevan, which I have already mentioned, and the arrival here this evening brings the story up to date.

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## This and That

MARKED similarity between the geological features of the Sudbury district and the platinum areas in the Union of South Africa is noted by the visitors from the Union. Copper, nickel, chromium, and the metals of the platinum group are found in both regions, though in different proportions. Incidentally, nickel and copper as by-products are counted upon to afford a considerable credit against the cost of producing platinum in South Africa. Most of the preliminary calculations by the larger companies, planning to exploit platinum, were based on a $40 market, instead of one of $100 or $110. In the opinion of J. G. Lawn, consulting engineer for the Barnato group, a thriving platinum mining industry could be built up, if an unlimited market for the output could be assured at about $30 for platinum and, say, $20 for palladium. The palladium content is important. An unlimited market, of course, would mean that huge works could be built, and that operating costs would be low as a consequence of large-scale treatment. The present method is to concentrate the ore by flotation, or otherwise, and export the concentrates.

* * *

R. E. Palmer, president of the Institution of Mining and Metallurgy (London) and technical director of the Rio Tinto mines in Spain has related to me a very interesting comparison between the present conditions and those prevailing before the war. Prior to 1914, labor at Rio Tinto was plentiful and wages were low—averaging about 75c. per day. Except where speed was a vital factor, it was cheaper to do things by hand than to install mechanical equipment. This applied to breaking ore, loading and hauling it. All told about 16,000 men were employed to produce 2,500,000 tons of ore per annum.

Wages were increased somewhat during the war, and, after the labor "revolution" in Spain in 1921, still further advances were necessary. Since then the average has been about $1.75. This readjustment in the wage made it profitable to introduce mechanical methods. Air drills had been used before for development work; but now they have been adopted for ore-breaking operations as well. Loading of ore by manual labor has given place to the use of "jigging conveyors," operated by electric power; and electric motor haulage equipment has been installed. As a result the same tonnage of ore is now mined with just half the average number of men, in spite of a wage scale that is more than twice as high. The profits are virtually the same as before the war.

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One of the most distinguished men in the Congress is Samuel Evans, chairman and managing director of Crown Mines Ltd., the largest gold mine in point of tonnage milled in the world. It is exceeded only by Government Areas in the value of yield. Mr. Evans in inclined to be rather pessimistic over the future of gold mining on the Rand, principally because of what he terms "plausible, but unwise and extravagant experiments in state socialism," and the attitude of the Union government toward large enterprize. Unless new capital is forthcoming, the mining industry must decline rapidly; and the present policies of the government agencies tend to repel rather than attract capital. Comparatively little is being done toward the development and equipment of new mines. There is little inducement under present conditions for capitalists to spend money for this purpose. Taxes

may total as much as 35 per cent of net profit; and burdensome laws affecting labor and customs tariffs tend to increase the costs of gold production unduly.

Mr. Evans was favorably impressed with the size and permanence of the mining and milling plants in the Porcupine area. In fact, from the incomplete information that he obtained regarding the character and extent of the ore deposits, he was inclined to wonder whether so large a scale of operations, as apparently is contemplated, is warranted from the standpoint of maximum profit to the shareholders. He emphasized the fact, however, that only a very thorough analysis of complete data would enable him to express an opinion on the point.

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At the technical session in Winnipeg, George E. Cole, mine inspector in the Porcupine area, briefly presented his 138-page paper "The Development of Gold Mining in Canada." He quoted "Spike" Mackenzie, the genial secretary—whoever saw a secretary who was anything but genial—as saying that one good thing about the paper was that it was too long to read. Another friend, after reading it, is reported by Mr. Cole to have said, "Well, George, I hope some day you will do something original." Howsoever, the paper gets between two covers a wonderfully complete résumé of the gold mining industry of Canada.

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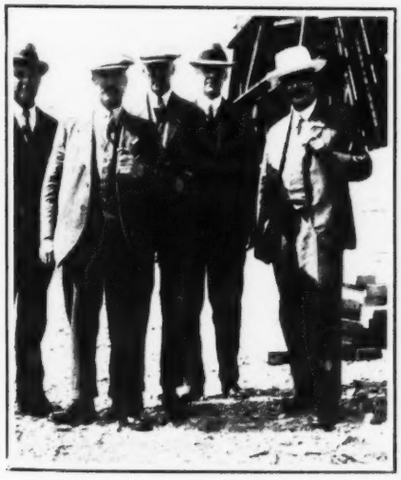
Among the many members of the Congress who tried their luck on the ponies at the races in Winnipeg, Saturday afternoon, and among the few whose operations in this connection were profitable to themselves, were Mrs. Craib of South Africa, and Mrs. Lilburne of Federated Malay States. Their system was simple: They backed the steeds whose names appealed to them. For instance "Six Pence" sounded good; and he breezed home in the fourth race much to the surprize of the talent. W. G. McBride got a ticket on this animal by mistake, and found that he had won only after the race was over.



*Left to right—H. Kee, McIntyre staff; R. C. Laird, Malvern, England; R. Cosser, McIntyre staff; H. Park, manager of Nipissing Mines; W. T. Anderson, London*

**Inspect McIntyre's New Headframe**

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Henry Hanson left the Congress at Winnipeg to fly to the Long Lake area where he is just completing the erection of a cyanide plant of 200-ton capacity for the Central Manitoba Mines, Ltd. The flow sheet shows the trend of ideas in cyanide treatment in the North Country. It includes: Jaw crusher, gyratory crusher, ball mill in open circuit, tube mill in closed circuit with classifier, primary thickener, two agitators in series, primary disk vacuum filters, and secondary disk filters, with re-pulping in barren solution between the two filtrations.

* * *

Competition has its advantages in more ways than one. The Red Special dining cars are operated by the Canadian Pacific Railway; those on the Blue Special by the Canadian National Railways. Each of the roads takes great pride in its dining service, and as various delegates frequently "dine out" on the other train and have an opportunity to compare the two, no effort is spared to provide the best. Obviously, the beneficiaries of this rivalry are the delegates.

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R. H. Webb, mayor of Winnipeg, is an ardent advocate of amity and cooperation between the great English-speaking nations. He travels much in the United States, and when he is down there he looks upon that country as a part of the British Empire. Moreover, he wants visitors in Manitoba from the United States to consider his province as one of the states of the Union. Reciprocity and novelty at least are in this notion.

* * *

G. A. Denny, long a prominent figure in the mining industry of South Africa, is not one of those who believes that the Rand has reached its zenith. Although it is possible that some decline in output may develop during the next three or four years, he is convinced that with the opening for exploitation of the large nearly horizontal reefs, now almost untouched, the aggregate output will grow to proportions exceeding anything in the past.

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B. Lightfoot, of the Geological Survey of Southern Rhodesia, foresees increased production of asbestos from the big deposits in that country as soon as a railway now half completed is in operation. At present the output is hauled 65 miles to Selukwe by bullock teams. There are nearly 300 carts, each drawn by several span of bullocks, and the problem of feeding them makes transportation expensive.

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Provincial ministers and other officials in Ontario travel in state at the taxpayer's expense. At least two of them hitched private cars onto the special trains of the Congress while it was sojourning in the province.

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J. B. Sneddon, of Scotch Oil, Ltd., the only important producer of oil from shale, says that his company is mining 6,000 tons of shale containing 20 gal. per ton. Reserves are sufficient for 40 years at the present rate of production.

*Left to right—G. J. V. Clarence, Johannesburg; M. Ford, South Africa; A. S. Howie, Scotland; A. S. Lilburne, Federated Malay States; H. R. Stafford, Burma; W. Brainerd, Montreal; F. Tierney, New York; J. Grant, general manager of Wright-Hargreaves*

**On the Steps of Wright-Hargreaves' Office Building**

## History of Tin Mining in Dutch East Indies

AN interesting report on the tin industry of the Dutch East Indies has recently been prepared by A. Guyot van der Ham, a retired engineer of the government mining service of the Dutch East Indies.

Mr. van der Ham states that tin ore is found and worked not only on the island of Banka, but on the islands of Billiton and Singkep, as well as in the Sumatra West Coast Residency, near Bangkinang. The first tin mines on the island of Billiton date from the year 1852; the original concession was transferred in the year 1860 to the Billiton Co., which concern worked the tin mines up to June 1, 1923, and at present is still a member of the direction of the Billiton Joint Mining Co.

On Singkep, a large island in the south of the Lingga-Archipelago, the native population already by the end of the 18th century carried on tin mining, but it was only in 1887 that the Sultan of Riouw and Lingga granted a concession for a working of the alluvial tin fields located in the sea on the southeast coast of Singkep.

The discovery of tin ore near Bangkinang, on Sumatra, is of recent date. In 1926 the working of these fields was started by the Stannum Mining Co., established in 1920 by the direction of the Billiton Co. It is worthy of note that ex-employees of the Billiton Co., from 1873 till 1878, explored tin fields in Siak in the present government of Sumatra's East Coast, with, however, little success.

There are further known to exist in the Dutch East Indies alluvial tin fields on some of the islands of the Riouw Archipelago. On two of these islands—Karimoen and Koendoer—the working of the fields will be undertaken by the Netherlands India Tin Exploitation Co., which company was established by the Billiton Joint Mining Co., and the Billiton Co., on Oct. 8, 1926.

With regard to the statistical position of the Dutch East Indies among the tin-producing countries of the world, it occupied before 1922 the third and in 1923 and 1924 the second place. As its tin production during the year 1925 was a little less than the production of Bolivia, it occupied the third place in that year.

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## Michigan College Prepares Industrial Exhibit

A comprehensive demonstration of the industrial and economic importance of the mining industries of upper Michigan will be exhibited at the 1927 Michigan State Fair in Detroit by the Michigan College of Mining and Technology in conjunction with an exhibit by the Upper Peninsula Development Bureau. Prof. R. R. Seeber, of the department of mechanics and electrical engineering, is arranging the exhibit, which will be an elaboration on last year's demonstration.

## Thames, New Zealand, Holds Diamond Jubilee

*Country's Oldest Gold Field Was Declared Open to Mining Interests in 1867*

THAMES, New Zealand's oldest gold field, celebrated its diamond jubilee last month. It is situated on the shores of the Hauraki Gulf which gives its name to the Hauraki gold field, embracing such well-known mining districts as Waihi, Karangahake, Coromandel, and Te Aroha. The district was declared a gold field on July 30, 1867. Prior to that date it was in the hands of the Maoris, the natives of New Zealand. Within ten days from the opening of the district one of the richest finds in the history of the field was made in the bed of the Karanui Creek. It was the Shotover mine, generally known as Hunt's claim. The ground is today included in the Kuranui Gold Mining Co.'s lease. There have been many rich discoveries on the Thames field, and although work at the deeper levels has not been very successful, there are today hopes of a revival, particularly in the Moanataiara and Alburnia mines. The former, between the years 1868 and 1888, paid dividends to its shareholders of £121,-365. In the 'seventies the Alburnia distributed over £30,000 to its shareholders, and a rich patch struck in the following decade resulted in a further £72,500 of profits for the shareholders in the new company that had been formed. Another profitable mine was the Cambria, which between the years 1885-1886 paid £77,122. On a capital of only £440 the Imperial between 1882 and 1886 yielded 43,094 oz., and distributed profits to the amount of £60,-750. The mines were notoriously patchy, and this led to heavy speculation.

In the large bluff between the Moanataiori and the Waiotahi creeks, the greatest bonanza ever found in New Zealand was discovered. The reef passed through the Manukau, Golden Crown and Caledonian mines returning handsome profits to each. The Caledonian was perhaps the greatest of all the Thames mines. The ore was in places worth 11 oz. to 50 oz. per ton, and in the year 1871 gave returns to the value of £975,000. Altogether between 1870 and 1872 its greatest period, the Caledonian company paid dividends to the tune of £198 10s. per £12 share. The year of the field's greatest production was 1871 when the value of the gold entered for export amounted to £1,188,-708. This was due principally to the rich shoot of ore discovered in the Golden Crown mine, and traced into the Caledonian mine, which enabled the latter to pay in dividends £553,440 in twelve months. The last boom was in the year 1906-1907 when the Waiotahi mine yielded gold to the value of £368,-500. Plucky investors cling to the hope that all the rich reefs have not yet been opened up, and in certain quarters a spirit of optimism prevails.

## Opposes Hydraulic Mining in California

AT A meeting of the mineral resources committee of the Commonwealth Club of San Francisco on Sept. 7, 1927, Otto Von Geldern, consulting engineer, presented a paper opposing resumption of hydraulic mining in California. On economic lines he presented an argument designed to show that hydraulic mining could not be profitably conducted under present conditions. He averred that the Yuba River watershed presented the best opportunities for hydraulic mining and that the proposed dam at the Narrows on the Yuba River would be the best site for resumption of hydraulic mining. He contended that a dam would not hold back débris during freshets and that when filled it would constitute a menace to the Valley farmers. Such a dam would be an experiment and neither its stability nor its efficiency could be assured. He also contended that the dam would be of little value for power and irrigation purposes. Von Geldern espouses the cause of the farmers. F. B. Noyes who represented the Sacramento Valley Anti-Débris Association argued that the profits from hydraulic mining would be more than offset by damages done to farms and navigation interests. James Stewart on behalf of the hydraulic miners questioned the conclusions drawn by Von Geldern and Noyes and read a letter which indicated that the farmers are not unanimous in the contention that hydraulic mining will be harmful to them.

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## State Meeting of A. I. M. E. and Congress at Globe

The Arizona section of the American Institute of Mining and Metallurgical Engineers and the Arizona chapter of the American Mining Congress will hold a joint meeting at Globe, Ariz., on Oct. 10 and 11. A number of papers on technical subjects, mine taxation and other mining matters will be presented. A feature of the entertainment program will be a luncheon and handicap golf tournament at the Cobre Valley country club. Trips through the mines, the mills and the smelter have also been arranged.

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## Central Washington Mining Association Formed

Organization of the Central Washington Mining Association was effected at the three-day central Washington mining congress held at Wanatchee, Sept. 1, 2 and 3. Winfield Harper of Wenatchee was elected president of the body, which has as its aim the stimulation of activity in the mining industry in one of the oldest producing districts of the state, that along the Columbia River. Other officers elected were Jay Lonergan, vice-president, and C. Hunter Martin, secretary-treasurer, both Wenatchee men.

# Personal Notes

W. F. Anderson, of Diamantina, in the state of Minas Geraes, Brazil, is in New York.

Sydney H. Ball, of Rogers, Mayer & Ball, is spending a month in Mexico on professional business.

Louis D. Huntoon, who has been in Canada, was expected in New York about Sept. 15.

Russell J. Spry has changed his place of residence from Denver to Spokane.

James Douglas is at Toronto, Canada, and will visit the mines at Sudbury.

C. Q. Schlereth sailed from New York on the "Duilio" on Sept. 17 for Greece, expecting to be abroad for several months on professional work.

Donald M. Liddell recently returned from an extensive trip to England and Spain and will resume his practice as chemical and metallurgical engineer with Weld & Liddell in New York.

M. N. Short, of the Geologic Branch of the U. S. Geological Survey, has accepted a position as lecturer at Harvard University, but will continue part-time work for the Survey.

S. G. Porter has been appointed manager of the department of natural resources of the Canadian Pacific Railway in succession to P. L. Nasmith, who has resigned.

R. G. Brown, formerly with the Benguet Consolidated Gold Mining Co., in the Philippine Islands, arrived in New York last week by way of London. He left on Sept. 14 for New Mexico.

W. H. A. Lawrence, assistant manager of the Central Mining & Investment Corporation, Ltd., accompanied by his wife and son, has left Johannesburg for a holiday in England.

Dorsey J. Parker, emergency engineer of the U. S. Bureau of Mines station at Berkeley, stopped off in Salt Lake to attend meetings of the A.I.M.E. on his way east to the international mine safety meet at Pittsburgh.

Jerome Ritchie, of the Albu Group, J. L. van Eyssen, of Lewis and Marks, and E. A. H. Cohen, of Investments, Ltd., recently arrived in Windhoek, South West Africa, and left there for the north to investigate various mineral deposits.

Arthur Moore, general manager of the New Guinea Oil Co., has been elected a member of the British Institute of Petroleum Technologists. Mr. Moore has had a long experience in boring, both for artesian water and oil, in Queensland, Australia, and before going to New Guinea was in charge of a government oil bore at Roma, Queensland.

H. De Witt Smith, assistant managing director, United Verde Copper Co., was in San Francisco recently en route to New York.

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Theodore Pilger, American mining engineer, who has for the last three years been traveling in Europe reporting to the Department of Commerce on economic and trade conditions, is returning to Washington, D.C., about Oct. 1. Mr. Pilger's work as American Trade Commissioner, with headquarters at Berlin, Germany, has furnished him

*Theodore Pilger*

with a wide knowledge of European economic conditions. A consulting itinerary will be arranged for him by the Bureau of Foreign and Domestic Commerce, covering a number of months traveling in the United States, conferring with American exporters and others interested in the European economic field. Mr. Pilger can be reached by mail, care of the Bureau of Foreign and Domestic Commerce, Washington, D.C.

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Irving S. Josephs, mining engineer of New York, has made an examination of the Cline gold property, in the Lochalsh-Goudreau area of northern Ontario, where some rich showings have been encountered.

R. D. Ferron has recently returned to the United States from Bolivia where he has been working on the placer tin deposits of that country. He plans to take a vacation of two or three months here before returning to Bolivia, making his headquarters in Los Angeles.

E. H. Rose, accompanied by his wife, has returned from Bolivia and spent a few days in New York City last week, en route west. Mr. Rose was recently mill superintendent for the Patiño Mines & Enterprises Consolidated, at Oruro, and before that was employed at the Nacozari mill of the Phelps Dodge Corporation, in Mexico.

A. J. McDermid, who was injured in a mine accident in May, has been discharged from the hospital and is now convalescing at his home in Miami, Ariz.

M. W. von Bernewitz attended the regional meeting of the A.I.M.E. at Salt Lake City during the last week of August, and later visited mines, mills, and smelters in Utah; also the Portland mine and mill at Cripple Creek, Col.

Charles W. Wright and his brother, Clarence A. Wright, consulting engineers for the Societá Atesina per Esplorazioni Minerarie, with headquarters at 370 Via Lunga, Merano, Italy, are now in the United States. C. W. Wright has bought a home for his family at 2128 Wyoming Ave., Washington, D.C., but will return to Italy around the first of November. He speaks very enthusiastically regarding the work of the Mussolini régime in Italy. C. A. Wright will return to Italy about Sept. 20. The interests by whom Messrs. Wright are employed have several mining properties in various sections of Italy.

W. H. Corbould, who recently made a second visit to London from Queensland, Australia, in connection with the financial affairs of the Mount Isa Mines, Ltd., has resigned as managing director and been appointed advisory director of that company as reorganized. He and two other Mount Isa directors gave up their positions on the board to make room for the appointment to the Mount Isa directorate of representatives in London of the Russo-Asiatic Consolidated, Ltd., which has acquired a controlling interest in the Mount Isa company. Mr. Corbould is to remain in London for some time to consult with the experts of the Russo-Asiatic company as to the methods of treating Mount Isa ore.

## OBITUARY

Colonel William Libbey, of the New Jersey National Guard, formerly professor of physical geography, geology, and archaeology at Princeton University, died at Princeton on Sept. 6. He was seventy-two years old.

William A. Ramsay died recently in Santa Paula, Calif. Mr. Ramsay was prominently identified with the early development of Cripple Creek, was business manager for Stratton, and negotiated the sale of the Independence to the Venture Corporation. He had not been active in mining for fifteen years or more.

Charles Sumner Smith, president of the Old Dominion and Arizona Commercial Copper companies, died at his home in Lincoln, Mass., on Aug. 28. He was seventy years old. Mr. Smith had been president of the Old Dominion company for the last twenty-five years. He is survived by his son, Charles S. Smith, Jr., and a brother, J. Waldo Smith.

# MARKET AND FINANCIAL NEWS

## Mineral Production of United States Showed Increase in 1926

In 1926, the industries producing minerals in the United States and preparing or reducing them for use were, as a whole, maintained at a higher level of productivity than during 1925, a year of marked prosperity and high records in output, declares Frank J. Katz, of the United States Bureau of Mines, in a review just made public. Only a few important products deviated sharply from this general condition.

Measured by the total value of mineral products—$6,262,000,000—the output of 1926 was the next largest ever recorded. Although the corresponding figure for 1920 is $6,981,340,000, price levels have so declined since that year, when they were at their peak, that the real value of the nation's mineral production for 1926 represents at least an appreciable, if not a substantial, increase over 1920. As compared with the values of the total mineral output for 1923, 1924, and 1925, in which years the average price levels of all commodities were not materially different from that of 1926, increases of 5 per cent, 18 per cent, and 10 per cent, respectively, are indicated.

All the mineral fuels were produced in larger quantities in 1926 than in 1925. The total output of bituminous coal closely approximated the war record and exceeded the record made in 1923, a more normal year. Anthracite production was evenly maintained at a good rate after the strike settlement late in February. The year was otherwise free from domestic coal-mining disturbances. Consumption was high, exports during much of the year were extraordinarily heavy because of the strike in Great Britain, and demand was further augmented by heavy buying for storage.

A new record in the output of crude petroleum was attained by gradual increase throughout the year; nevertheless stocks of crude petroleum were considerably reduced throughout the year, thus reflecting the growing refinery throughout and heavier demand for refined products. Prices in general were above those for 1925. Increases in the production of natural gas and its co-products, natural-gas gasoline and carbon black, are recorded for 1926.

The aggregate value of the output of metals in the United States in 1926 showed a small increase over 1925. Among the metals of major importance, the most notable large increase was shown by zinc, whereas gold and silver showed notable decreases. The production of gold continued the decline which set in about 1916. The average price of silver in the United States in 1926 was 7c. an ounce less than in 1925, causing a decrease of about one-seventh in the total value and a smaller but appreciable decrease in the quantity produced.

The domestic production of copper increased moderately. Imports of copper into the United States were larger, whereas the slackening of foreign demand is indicated by smaller exports. A marked increase in domestic demand was, however, insufficient to offset these factors, and domestic stocks increased. The price trend was slightly downward.

The lead and zinc industry in 1926 was characterized by record production, intense activity, high prosperity, and excellent demand, although price levels were slightly lower than in 1925 and declined during the year.

In magnitude of production, the iron and steel industry recorded a remarkable year in 1926. The production of steel was the largest ever recorded, and the production of pig iron was only a little less than in 1923, the record year. The output of iron ore was notably greater than in 1925 but still well below 1917, the banner year. The average price of ore for 1926 was virtually the same as in 1925. Prices for iron and steel were slightly lower, however, and consumption slightly higher.

The outstanding features with respect to manganese in 1926 were the smaller domestic production of high-grade ores, the extraordinary figures for the production of ferromanganese based on imported ores, the stable demand for manganese and manganese products, and the downward tendency of prices. The domestic production of mercury also decreased, but larger imports indicated corresponding increases in consumption, and prices rose materially during the year. There was virtually no production of chromite in the United States in 1926, but important increases in imports and the growing use of chromite as a refractory material are noted. Antimony mining and smelting in the United States in 1926 was at low ebb, despite the growing demand, which was met by increased imports from Mexico and Bolivia in addition to the Chinese supply. Prices were lower than in preceding years. Aluminum was produced in the United States during the year at about the same rate as in 1925; there was also little change in price.

In contrast to the moderate increase shown in the aggregate value of the output of metals, the value of nonmetallic mineral products, not including fuels, showed a slight decline in 1926 as compared with that of 1925, but nevertheless remained at a high level in relation to preceding years. The aggregate volume of production of mineral structural materials, including building stone, crushed stone, sand and gravel, lime, gypsum, and cement, indicated that the demand for structural materials in 1926 had changed but slightly as compared with 1925. The average values of these materials changed little during the two years. The output of building stone and crushed stone, considered separately, increased somewhat, whereas the production of sand and gravel for concrete aggregate, and of lime and gypsum was about the same. Portland cement was produced in larger volume in 1926 than in 1925. Although sales of cement were larger than in the preceding year, they were less than production; producers, therefore, accumulated stocks of finished cement in unprecedented amounts.

Among the ceramic materials, feldspar alone showed material increase in 1926 over 1925 and established a new high record. Clay declined slightly in output; the total, however, remained higher than in other years before 1925. The mineral chemical materials, including fertilizers, pigments, metallurgical fluxes, and refractories in general, showed little change or small decreases in 1926. Fluorspar, however, was an exception with material increase in the quantity and value of production marketed. Among the miscellaneous general industry minerals such as graphite, abrasive materials, fuller's earth, mica, asbestos, and talc and soapstone moderate increases in production were largely the rule in 1926, with demand and prices generally well sustained at the 1925 levels.

The importance to the modern world of the numerous and varied mineral industries and the extraordinary dependence of our economic civilization upon them are not indicated by their physical volume or their money value, Mr. Katz points out. Better appreciation of their importance is developed, for example, by realizing that the mineral raw materials of domestic origin constitute more than half, and, plus the products thereof in the first

stages of manufacture, more than two-thirds of the freight handled by the railroads of the country; that steel, which supplies the framework and the thews of our body economic as well as politic, is the product of the iron-ore and coal mines; and that the supply of energy available and utilized in this country, a vital factor in our industrial supremacy and high standard of living, is nearly 90 per cent derived from mineral fuels.

Detailed information in regard to the country's mineral production in 1926 is contained in the preliminary summary of "Mineral Resources of the United States," for that year, just published by the Bureau of Mines, copies of which may be obtained from the Superintendent of Documents, Washington, D. C., at a price of 20 cents.

## Broken Hill Prop. and Block 14 May Suspend Operations

Suspension of operations at Broken Hill was adumbrated by the chairman of the Broken Hill Proprietary Company at a meeting of the shareholders recently held in Melbourne, Australia. The reduction of the working hours underground from 44 to 35 per week and the reduction of the working day to two shifts with certain legislative acts such as the Child Endowment and Workmen's Compensation has more than off set the benefits resulting from the improved appliances and methods. In concluding his speech, the chairman said that it was difficult to forecast the future of the lead market but unless the price increased materially within three to four weeks both the Broken Hill Proprietary and Block 14 would close. The Broken Hill Proprietary output for 1926 was some 27,000 tons of lead concentrates and 18,700 tons of zinc concentrates; the Block 14 output for the half year ended September, 1926, was about 5,000 tons of lead concentrates and 3,600 tons of zinc concentrates.

## Rand Mines Make £6,500,000 Profit For Half Year

Transvaal gold production and kindred statistics are given in the table which follows. Working costs per ton milled averaged 8.86s. and the dividend distribution amounted to £4,113,829 during the six months' period. The total output of gold was 5,018,279 fine oz. Working costs do not include expenditure charged to capital account. The table has been compiled from figures issued by the Transvaal Chamber of Mines:

**Transvaal Gold Mining Statistics**

| | Ore Milled, Tons | Gold Yield, per Ton Dwt. | Declared Revenue | Working Costs | Profits |
|---|---|---|---|---|---|
| January | 2,479,930 | 6.655 | £3,523,564 | £2,411,114 | £1,112,450 |
| February | 2,296,187 | 6.676 | 3,268,857 | 2,271,833 | 997,024 |
| March | 2,564,120 | 6.595 | 3,615,293 | 2,481,979 | 1,133,314 |
| April | 2,411,420 | 6.723 | 3,462,108 | 2,394,493 | 1,067,615 |
| May | 2,533,550 | 6.661 | 3,602,223 | 2,483,219 | 1,119,004 |
| June | 2,505,450 | 6.665 | 3,575,721 | 2,456,496 | 1,119,225 |
| Totals | 14,790,657 | 6.667 | £21,047,766 | £14,499,134 | £6,548,632 |

## United States Production of Gold and Silver in 1926

Gold and silver production in the United States continues to decline, according to estimates of the Mint Bureau and the U. S. Bureau of Mines. In 1926 the gold output was 2,335,042 oz., valued at $48,269,600, a decrease of $1,590,600 compared with 1925. The silver production amounted to 62,718,746 oz., valued at $39,136,497, based on the average New York price of bar silver of .624c. per ounce. This was a reduction of 3,436,678 oz. from the 1925 production. Production of gold and silver in ounces by states in 1926 was as shown in the subjoined table.

As compared with the preceding year's production, 1926 shows a reduction of $1,590,600 in gold, and 3,436,678 oz. in silver. The year of largest output was 1915, with gold $101,035,700, and silver 74,961,075 oz.

**U. S. Gold and Silver Production**

| States | Gold Ounces | Gold Value | Silver Ounces | Silver Value(a) |
|---|---|---|---|---|
| Alaska | 325,186 | $6,722,200 | 707,454 | $441,451 |
| Arizona | 232,200 | 4,800,000 | 7,516,708 | 4,690,426 |
| California | 581,700 | 12,024,800 | 1,977,956 | 1,234,244 |
| Colorado | 346,297 | 7,158,600 | 5,037,574 | 3,143,446 |
| Georgia | 140 | 2,900 | 11 | 7 |
| Idaho | 12,640 | 261,300 | 7,563,644 | 4,719,714 |
| Illinois | ..... | ..... | 3,081 | 1,922 |
| Michigan | ..... | ..... | 107,094 | 66,827 |
| Missouri | ..... | ..... | 71,839 | 44,827 |
| Montana | 57,707 | 1,192,900 | 11,974,257 | 7,471,936 |
| Nevada | 170,880 | 3,532,400 | 6,450,224 | 4,024,940 |
| New Mexico | 20,105 | 415,600 | 496,634 | 309,900 |
| North Carolina | 121 | 2,500 | 22 | 14 |
| Oregon | 13,303 | 275,000 | 28,861 | 18,009 |
| Pennsylvania | 106 | 2,200 | 1,479 | 923 |
| South Carolina | 15 | 300 | ..... | ..... |
| South Dakota | 286,961 | 5,932,000 | 82,789 | 51,660 |
| Tennessee | 416 | 8,600 | 95,783 | 59,769 |
| Texas | 164 | 3,400 | 463,611 | 289,293 |
| Utah | 181,832 | 3,758,800 | 19,936,032 | 12,440,084 |
| Vermont | ..... | ..... | 1,948 | 1,216 |
| Virginia | 10 | 200 | ..... | ..... |
| Washington | 8,833 | 182,600 | 155,952 | 97,314 |
| Philippine Islands | 96,426 | 1,993,300 | 45,793 | 28,575 |
| Totals | 2,335,042 | 48,269,600 | 62,718,746 | 39,136,497 |

(a) At $0.624 per ounce, the average New York price of bar silver.

## Hollesen, Inc. Announces Change in Organization

PHILIP L. SMITH, who has had the management of the ore and metal departments of H. Hollesen, Inc., importers and exporters, New York, N. Y., with connections and representatives in the principal markets of the world, has taken over the ore and metal business, commencing Sept. 1, 1927. All outstanding contracts as of August 31, 1927 in the above departments will be executed under the new firm name of Philip L. Smith, Inc., New York, which has been appointed sole representatives in the United States and Canada for the purchase and sales of ores and nonferrous metals, for account of N. V. Metaalassociatie, Rotterdam.

## Noranda Disposes of Output

The Noranda Mines, Ltd. has sold all its production for a number of years to the British Metal Corporation which made a better bid for the output than any other concern. A production of about 3,000,000 lb. of copper per month is expected. Until the British Metal Corporation's new refinery near Swansea, South Wales, is completed the purchaser will refine the metal on this side.

## STATISTICAL NOTES

HECLA MINING COMPANY'S operations during the second quarter of the year resulted in a profit of $416,933, against $556,039 for the first quarter. Details of the financial and technical information contained in a circular recently issued to shareholders are as follows:

| | First Quarter | Second Quarter |
|---|---|---|
| Gross income | $1,146,502 | $1,000,538 |
| Operating expenses | 408,637 | 434,504 |
| Taxes accrued | 113,000 | 82,000 |
| Depreciation | 68,826 | 67,101 |
| Total expenses | $590,463 | $583,605 |
| Net profit | $556,039 | $416,933 |
| Ore mined, tons | 85,980 | 81,919 |
| Lead produced, lb | 17,064,285 | 16,824,934 |
| Silver produced, oz | 507,115 | 489,576 |

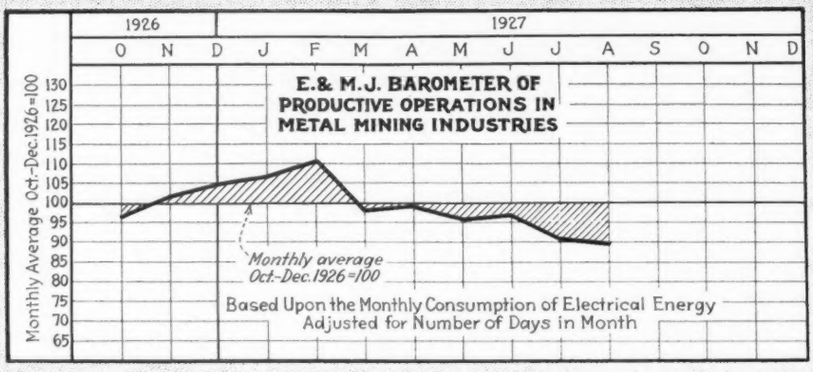
BURMA CORPORATIONS July operations resulted in the production of 6,441 tons of crude lead, 5,500 tons of refined lead, and 482,900 oz. of refined silver. Other figures of the July operations are as follows:

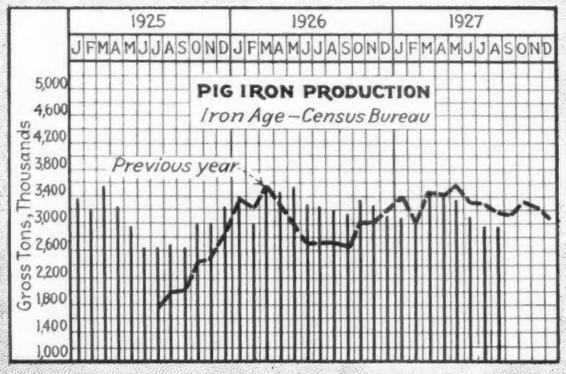
| | Long Tons |
|---|---|
| Ore mined | 35,284 |
| Ore milled | 26,700 |
| Lead concentrates produced | 9,912 |
| Lead-bearing material smelted | 14,321 |
| Crude lead produced | 6,441 |
| Zinc concentrates produced | 4,610 |

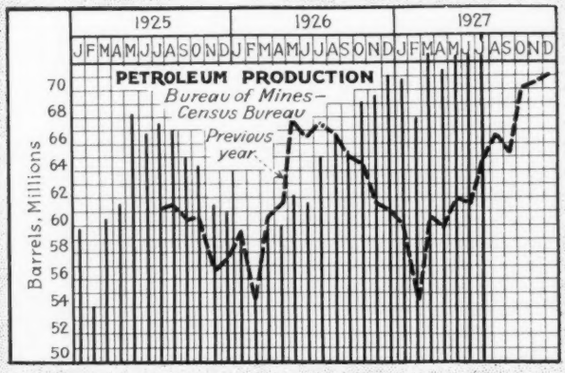
NATIONAL SMELTING CO., which has a capital of £1,700,000, and whose chairman is Sir Robert Horne, made a net profit last year of £330,752. Dividends of 10 per cent were paid, absorbing £102,000; £100,000 was placed to reserve, £27,280 to depreciation reserve account, and £137,820 is carried forward.

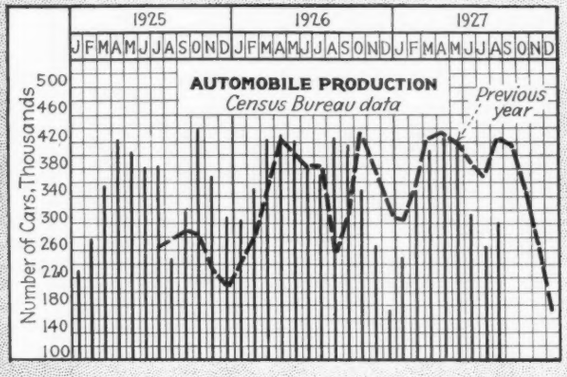
# Indicators of Industrial Activity

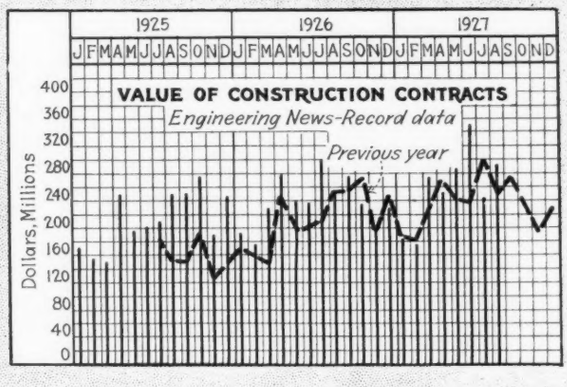
*of Significance to Mining*

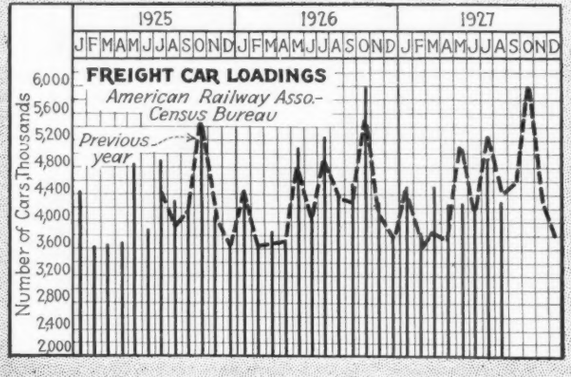

1926
1927
O N D J F M A M J J A S O N D
E.& M.J. BAROMETER OF PRODUCTIVE OPERATIONS IN METAL MINING INDUSTRIES
Monthly Average Oct.-Dec.1926=100
130 125 120 115 110 105 100 95 90 85 80 75 70 65
Monthly average Oct.-Dec.1926=100
Based Upon the Monthly Consumption of Electrical Energy Adjusted for Number of Days in Month

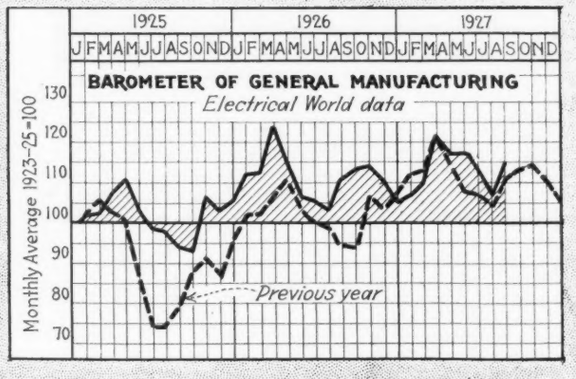

1925
1926
1927
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
PIG IRON PRODUCTION
Iron Age—Census Bureau
Previous year
Gross Tons, Thousands
5,000 4,600 4,200 3,800 3,400 3,000 2,600 2,200 1,800 1,400 1,000


1925
1926
1927
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
PETROLEUM PRODUCTION
Bureau of Mines—Census Bureau
Previous year
Barrels, Millions
70 68 66 64 62 60 58 56 54 52 50


1925
1926
1927
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
AUTOMOBILE PRODUCTION
Census Bureau data
Previous year
Number of Cars, Thousands
500 460 420 380 340 300 260 220 180 140 100


1925
1926
1927
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
VALUE OF CONSTRUCTION CONTRACTS
Engineering News-Record data
Previous year
Dollars, Millions
400 360 320 280 240 200 160 120 80 40 0


1925
1926
1927
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
FREIGHT CAR LOADINGS
American Railway Asso.-Census Bureau
Previous year
Number of Cars, Thousands
6,000 5,600 5,200 4,800 4,400 4,000 3,600 3,200 2,800 2,400 2,000


1925
1926
1927
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
BAROMETER OF GENERAL MANUFACTURING
Electrical World data
Previous year
Monthly Average 1923-25=100
130 120 110 100 90 80 70

# The Market Report

## Copper and Other Metal Sales Improve But Market Not Yet Active

*New York, Sept. 14, 1927*—As was expected, the metal business in the week ending today has shown an improved tone, but there is not yet any buying movement of importance going on in any of the metals. Copper and silver prices are slightly higher than a year ago; zinc is unchanged; and lead and tin have declined.

### Copper More Active

The copper market seems to have awakened from its slumbers of the last four weeks. A larger tonnage of the metal has been sold during the week under review than during any week since Aug. 3 and the keener interest shown by consumers has resulted in less cutting of the prices asked by the large producers, 13.20c. delivered being about the lowest quotation today. Sales in the Middle West commanding the full 13⅜c. had the effect of somewhat raising the average price on Thursday, Friday, and Saturday since sellers were not willing to shade this figure.

Advices from Europe leave little room for doubt that France, England, and Germany are all underbought and sales there, at the export association price of 13½c., c.i.f., are improved. Ample evidence of meager stocks held by consumers in this country also is afforded by the continued requests to sellers to deliver at earlier dates than those specified in the original contracts. It seems highly improbable that more than an insignificant proportion of November copper has yet been bought and the large volume of prompt sales indicates that some September and much October copper is still to be purchased.

### Lead Scraping Bottom?

With New York lead at 6¼c., St. Louis lead at 6c., and the London price between £21 and £22, producers feel that the market is scraping bottom and that consumers waiting for further concessions in the immediate future are likely to be disappointed. Statistics issued today showed crude production in the United States and Mexico somewhat reduced in August, being 79,701 tons, compared with 81,999 in July; refined, on the other hand, increased from 76,518 tons in July to 78,378 tons in August, and antimonial lead from 1,287 to 1,493, so no cut in production is yet particularly apparent. Stocks of refined lead showed a healthy decrease, from 48,942 to 43,189 tons, however, which, in view of unusually small amounts in the hands of consumers, is distinctly encouraging as indicating better consumption. Cable manufacturers continue disappointing in their requirements, but the battery business seems to be picking up, and some good sales of lead have been made during the week to corroders and manufacturers of "blue lead" products. Following concessions in the outside market, the American Smelting & Refining Co. reduced its contract price for New York lead on Sept. 9 from 6.40c. to 6.25c. The St. Louis market for chemical lead has settled to 6c., which is generally quoted by all sellers. Desilverized, however, commands about 6.10c. there.

### Zinc Still 6¼c.

Zinc has again been quieter than usual, with Monday and Tuesday the best days. The same price has ruled practically all week, 6¼c., St. Louis. Some October and November metal has been sold. The August statistics issued by the American Zinc Institute follow, in tons of 2,000 lb.:

| | |
|---|---|
| Stock, Aug. 1 | 39,323 |
| Produced | 49,012 |
| Shipped | 53,748 |
| Stock, Aug. 31 | 34,587 |
| Shipped from plant for export | 4,009 |
| Retort capacity, Aug. 31 | 134,684 |
| Number retorts operating, Aug. 31 | 76,851 |

A healthy decrease in stocks is evident.

### Daily Prices of Metals

| Sept. | Copper | Tin | | Lead | | Zinc |
|---|---|---|---|---|---|---|
| | Electrolytic, N. Y. | 99 Per Cent | Straits | N. Y. | St. L. | St. L. |
| 8 | 12.90@13.05 | 62.50 | 63.50 | 6.35@6.40 | 6.00@6.125 | 6.25 |
| 9 | 13.00 | 62.50 | 63.375 | 6.25 | 6.025 | 6.25 |
| 10 | 13.00 | 62.00 | 62.875 | 6.25 | 6.00 | 6.25 |
| 12 | 12.85@12.90 | 61.875 | 62.375 | 6.25 | 6.00 | 6.25@6.275 |
| 13 | 12.95 | 61.375 | 61.875 | 6.25 | 6.00 | 6.25 |
| 14 | 13.00 | 61.625 | 62.25 | 6.25 | 6.00 | 6.25 |
| | 12.967 | 61.979 | 62.708 | 6.271 | 6.015 | 6.252 |

Average prices for calendar week ending Sept. 10, 1927, are: Copper 12.975; 99 per cent tin, 62.550; Straits, 63.500; N. Y. lead 6.333; St. Louis lead, 6.058; zinc, 6.250; and silver, 55.150.

**The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.**

**Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.**

**In the trade, copper prices usually are quoted on a delivered basis; i.e., delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.**

**Quotations for copper are for ordinary forms of wire bars, ingot bars, and cakes. For ingots an extra 0.05c. per pound is charged and there the other extras for other shapes. Cathodes are sold at a discount of 0.125c. per pound.**

**Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.**

**Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.**

### London

| Sept. | Copper | | | Tin | | Lead | | Zinc | |
|---|---|---|---|---|---|---|---|---|---|
| | Standard | | Electrolytic | | | | | | |
| | Spot | 3M | | Spot | 3M | Spot | 3M | Spot | 3M |
| 8 | 54½ | 55 | 62 | 289 | 284¼ | 21 13/16 | 22⅜ | 27 7/16 | 27 7/16 |
| 9 | 54⅜ | 54⅞ | 61¾ | 289½ | 283¾ | 21⅜ | 21 15/16 | 27¼ | 27¼ |
| 12 | 54 5/16 | 54⅞ | 61¾ | 287⅞ | 281 | 21⅛ | 21¾ | 27 1/16 | 27 |
| 13 | 54 5/16 | 54⅞ | 61¾ | 284 | 278½ | 21 3/16 | 21 15/16 | 27¼ | 27¼ |
| 14 | 54 11/16 | 55 5/16 | 61¾ | 284¾ | 279¼ | 21 5/16 | 22 1/16 | 27½ | 27½ |

**The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.**

### Silver, Gold, and Sterling Exchange

| Sept. | Sterling Exchange "Checks" | Silver | | Gold London | Sept. | Sterling Exchange "Checks" | Silver | | Gold London |
|---|---|---|---|---|---|---|---|---|---|
| | | New York | London | | | | New York | London | |
| 8 | 4.85 11/16 | 55¼ | 25½ | 84s11½d | 12 | 4.85 11/16 | 55½ | 25⅝ | 84s11½d |
| 9 | 4.85⅝ | 55⅜ | 25 9/16 | 84s11½d | 13 | 4.85 11/16 | 55½ | 25⅝ | 84s11½d |
| 10 | 4.85¾ | 55¼ | 25½ | ..... | 14 | 4.85¾ | 55¼ | 25 9/16 | 84s11½d |
| | | | | | Avg. | | 55.354 | | |

**New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths cent premium.**

## Tin Quiet and Lower

Decreased tin-plate consumption and plentiful supplies have had a bearish effect on tin, which sold even below 62c. for prompt Straits yesterday, with forward about one-half cent less. A moderate business has been done each day.

## Foreign Exchanges Firm

Closing cable quotations on Tuesday, Sept. 13, were as follows: francs, 3.92⅛c.; lire, 5.45c; and marks, 23.79c. Canadian dollars, $\frac{1}{32}$ per cent premium.

## Silver Improved

During the past week the market has been much more active, at higher rates, with a good demand for Indian and Chinese accounts. Today, however, quotations have declined ¼c. on account of scarcity of orders from abroad.

*Mexican Dollars* (old Mexican pesos) —Sept. 8th, 41¾c.; 9th, 41⅞c.; 10th, 41¾c.; 12th and 13th, 42c.; 14th, 41¾c.

## Other Metals

**Quotations cover large wholesale lots unless otherwise specified. London prices are according to latest mail advices.**

ALUMINUM—Per lb., 98 or 99 per cent grade, price of leading interest, 26c.; outside market, 25.30@25.80c.

ANTIMONY—Per lb., duty paid. New York: Chinese brands, range for the week, spot business, 11⅜c. October arrivals ⅛c. higher. Market quiet. Cookson's "C" grade, spot, 17¾c. Needle antimony nominally 8c. for lump and 10c. for powdered. White oxide, 16½c.

BISMUTH—Per lb., New York, in ton lots, $1.85@$2.10. London, 8s.

IRIDIUM—Per oz., $106@$110 for 98 @99 per cent sponge and powder. Market dull.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade) for single lots of spot metal.

PALLADIUM—Per oz., $52@$54. Small lots bring up to $58. Market dull and prices nominal. Pure metal as a constituent of crude platinum, nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $72. Dealers and refiners quote the trade for refined metal, per oz., cash, $64.50@$66.

QUICKSILVER—Per 76-lb. flask, range for week $119@$120, nominal. Market shows little life. San Francisco wires $120.67. London, £21¾@£22.

Prices of Cadmium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of Sept. 3.

## Metallic Ores

MANGANESE ORE—Per long ton unit of Mn. c.i.f. North Atlantic ports, minimum 47 per cent Mn, 36@38c. Caucasian, washed, 53@55 per cent, 40c. Chemical grades unchanged from quotations in the Sept. 3 issue.

TUNGSTEN ORE—Per unit of $WO_3$, N. Y.: Wolframite, $10.25@$10.50. Western scheelite, $10.50@$10.75. Market somewhat more active.

Chrome, Iron, Molybdenum, Tantalum, Titanium, Uranium, and Vanadium Ores are unchanged from quotations in the Sept. 3 issue.

## Lead Ore Lower; Zinc Steady

*Joplin, Mo., Sept. 10, 1927*

| Blende | | Per Ton |
|---|---|---|
| High | | $44.90 |
| Premium, basis 60 per cent zinc | $43.00@ | 44.00 |
| Prime Western, basis 60 per cent zinc | | 42.00 |
| Fines and slimes, 60 per cent zinc | 38.00@ | 41.00 |
| Average settling price, all zinc | | 41.66 |
| **Galena** | | |
| High | | $87.40 |
| Basis 80 per cent lead | | 80.00 |
| Average settling price, all lead | | 85.50 |

Shipments for the week: Blende, 12,932; lead, 1,544 tons. Value, all ore the week, $670,790.

The situation today was peculiar in that a majority of the buyers seemed favorable to a cut in the price of zinc to $41 basis Prime Western, but ended in contracting supplies on an unchanged market. One buyer put it succinctly as follows: "It can be bought on $41 basis, but down will go a lot of mines." Even a continuation of the $42 basis has not prevented the output being lowered, estimated at 700 tons. The shipment leaves an increased tonnage of sold ore in the bins, falling more than 3,000 tons short of last week's purchase. The purchase this week was 12,180 tons.

The lowered price of lead is mostly applicable to smelter-produced tonnages, those holding stocks declining to market their holdings.

*Platteville, Wis., Sept. 10, 1927*

| Zinc Blende | Per Ton |
|---|---|
| Blende, basis 60 per cent zinc | $44.75 |
| **Lead Ore** | |
| Lead, basis 80 per cent lead | $82.50 |

Shipments for the week: Blende, 1,431 tons; lead, 40 tons. Shipment for the year: Blende, 46,663; lead, 1,250 tons. Shipment for the week to separating plants, 2,531 tons blende.

## Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the Sept. 3 issue.

## Mineral Products

ARSENIOUS OXIDE (White Arsenic) —Per lb., 4c. Market slack. London, Cornish white, per long ton, £17@ £17½.

Calcium Molybdate, Copper Sulphate, Sodium Sulphate (Salt Cake), Sodium Nitrate, and Zinc Oxide are unchanged from prices in the Sept. 3 issue.

## Ferro-Alloys

FERROMANGANESE—Per long ton, domestic and foreign, 78@82 per cent, $90, f.o.b. furnace, for delivery during second half 1927. Spiegeleisen, 19@21 per cent, $33@$35 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent, 93@96c. f.o.b. works. Dull.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, and Ferrovanadium are unchanged from prices in the Sept. 3 issue.

## Metal Products

ROLLED COPPER—Per lb., f.o.b. mill, sheets, 22c.; wire, 15¼c.

LEAD SHEET—Full rolled 10c.; clipped 10¼c. per lb.

Nickel Silver, Yellow Metal, and Zinc Sheets unchanged from prices in Sept. 3 issue.

## Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the Sept. 3 issue.

## Little Change in Steel

*Pittsburgh, Sept. 13, 1927*

Bessemer and open-hearth steel ingot production in August, as officially reported, was 3,470,903 tons, making with an allowance for electric and crucible ingots, about 3,500,000 tons, as forecast a week ago. There was practically no change in the rate of production from July to August, about 69 per cent of full capacity, and this month thus far has run substantially the same.

The Steel Corporation's unfilled tonnage has run practically the same for three months, showing slight increases.

The steel consuming lines show little change or prospect of change.

On account of lighter railroad requirements, slackness in oil and gas well drilling, lower automobile production, and slight decreases in a few other lines, steel production is running 15 per cent under that of a year ago, which seems a small decrease in the circumstances.

Finished steel prices are not quotably changed but in some lines they do not seem to be on a perfectly secure foundation.

*Pig Iron*—The market remains dull. Bessemer, $18; basic, $17.25; foundry, $17.50, f.o.b. valley furnaces.

*Connellsville Coke*—Prices on furnace coke, at $3@$3.25, and on foundry coke, at $4@$4.75, hold steady, with light demand.

# Mining Stocks—Week Ended Sept. 10, 1927

| Stock | Exch. | High | Low | Last | | Last Div. |
|---|---|---|---|---|---|---|
| **COPPER** | | | | | | |
| Anaconda | New York | 46⅝ | 45¾ | 46⅜ | Jy.16, Au.22 Q | 0.75 |
| Arcadian Consol. | Boston | ... | ... | *75 | | |
| Ariz. Com'l | Boston | 6 | 5½ | 5½ | Jy. 18, Jy. 30 | 0.25 |
| Calaveras | N. Y. Curb | ... | ... | 1⅜ | | |
| Calumet & Arizona | New York | 71¾ | 69⅜ | 69⅜ | Se. 9, Se. 26 Q | 1.50 |
| Calumet & Hecla | Boston | 16 | 15⅜ | 15⅝ | Au. 31, Se.15 Q | 0.50 |
| Cerro de Pasco | New York | 66 | 64½ | 65¼ | Jy.14, Au.1 Q | 1.00 |
| Chile Copper | New York | 36½ | 34⅞ | 36 | Se. 2, Se. 30, Q | 0.62½ |
| Con. Coppermines | N. Y. Curb | 2⅜ | 2⅜ | 2⅜ | | |
| Copper Range | Boston | 13¾ | 13⅛ | 13⅜ | Ap.2, My.2, A | 1.00 |
| Crystal Copper | BostonCurb | *37 | *30 | *34 | | |
| East Butte | Boston | 1½ | 1¼ | 1½ | Dec., 1919 | 0.50 |
| Granby Consol | New York | 41⅜ | 37 | 37⅜ | Jn.15 Jy. 1 Q | 1.00 |
| Greene Cananea | New York | 65½ | 60⅜ | 61 | Nov., 1920 | 0.50 |
| Howe Sound | New York | 40½ | 39 | 39 | Jy.1, Jy.15, Q | 1.00 |
| Inspiration Consol | New York | 19½ | 17 | 18⅜ | Ma.17, Ap.4, Q | 0.25 |
| Iron Cap | Boston Curb | 2⅝ | 2⅜ | 2⅜ | | |
| Isle Royale | Boston | 10½ | 10 | 10 | Fe.4, Fe.19, Q | 0.50 |
| Kennecott | New York | 73⅜ | 71⅛ | 73⅛ | Se. 2, Oc. 1, Q | 1.25 |
| Magma Copper | New York | 37½ | 36⅝ | 36⅝ | Jn.30, Jy.15, Q | 0.75 |
| Mason Valley | N. Y. Curb | *75 | *67 | *67 | | |
| Miami Copper | New York | 14⅛ | 14⅛ | 14⅛ | Au.1, Au.15 Q | 0.37½ |
| Mohawk | Boston | 43⅞ | 43 | 43 | Jy.30, Se.1 Q | 1.00 |
| Mother Lode Coal | New York | 2⅛ | 2⅛ | 2⅛ | Jn.10, Jn.30 | 0.25 |
| Nevada Consol | New York | 15⅞ | 14⅞ | 15⅝ | Se. 16, Se. 30 Q | 0.37½ |
| New Cornelia | Boston | 21½ | 21 | 21 | Au.5, Au.22 Q | 0.50 |
| Noranda | N. Y. Curb | 24⅜ | 23⅜ | 23⅞ | | |
| North Butte | Boston | 1⅛ | 1⅛ | 1⅛ | Oct., 1918 | 0.25 |
| Ohio Copper | N. Y. Curb | 1⅜ | 1⅛ | 1⅛ | Sept. 1926 | 0.03 |
| Old Dominion | Boston | 11 | 11 | 11 | Dec., 1918 | 1.00 |
| Phelps Dodge | N. Y. Curb | ... | ... | 116 | Jn.18, Jy.1 Q | 1.50 |
| Quincy | Boston | 16¼ | 15 | 15⅛ | March, 1920 | 1.00 |
| Ray Consolidated | New York | ... | ... | 15⅛ | Ap.20, Ap. 30 | 0.25 |
| St. Mary's Min. Ld. | Boston | 22 | 21 | 21 | Fe.10, Ma.10 | 2.00 |
| Seneca Copper | New York | 1⅜ | 1⅜ | 1⅜ | | |
| Shattuck Denn | Boston Curb | 4¼ | 4¼ | 4¼ | | |
| Tenn. C. & C. | New York | 9 | 8⅝ | 8⅝ | Au.31,Se.15, Q | 0.12½ |
| United Verde Ex. | N. Y. Curb | ... | ... | 24½ | Jy.6, Au.1 Q | 0.75 |
| Utah Copper | New York | ... | ... | 124 | Se. 16, Se. 30 Q | 1.50 |
| Utah Metal & T. | Boston | ... | ... | 1⅛ | Dec., 1917 | 0.30 |
| Walker Mining | Salt Lake | *54 | *51 | *51 | | |
| **NICKEL-COPPER** | | | | | | |
| Internat. Nickel | New York | 67¼ | 64 | 65⅛ | Se. 16, Se. 30 Q | 0.50 |
| Internat. Nickel pfd. | New York | 109 | 109 | 109 | Ap. 14, My. 2 Q | 1.50 |
| **LEAD** | | | | | | |
| Gladstone Mtn | Spokane | *14⅞ | *14½ | *14½ | June, 1927 | 0.005 |
| National Lead | New York | 125½ | 116 | 122 | Se. 16, Se 30 Q | 1.25 |
| National Lead pfd | New York | 110½ | 109⅜ | 110½ | Se.1, Se. 30 Q | 1.75 |
| St. Joseph Lead | New York | 41 | 40¼ | 40¼ | Se.10,Se.20, QX | 0.75 |
| **ZINC** | | | | | | |
| Am. Z. L. & S. | New York | 7⅛ | 5⅞ | 7⅛ | May, 1917 | 1.00 |
| Am. Z. L. & S. pfd. | New York | 38½ | 38 | 38½ | Nov., 1920 | 1.50 |
| Butte C. & Z. | New York | 4½ | 4 | 4¼ | De. 9, De. 24 | 0.50 |
| Butte & Superior | New York | 9 | 8⅞ | 9 | Se. 16, Se. 30 Q | 0.50 |
| Callahan Zn-Ld | New York | 1⅜ | 1⅛ | 1⅛ | Dec., 1920 | 0.50 |
| Consol.Lead&Zinc'A' | St. Louis | 12⅜ | 12⅛ | 12⅛ | Ma.15, Ap.1 Q | 0.25 |
| Eagle-Picher | Cincinnati | 26¼ | 26 | 26 | Au.15, Se.1 Q | 0.40 |
| Eagle-Picher pfd. | Cincinnati | | | 117½ | Jn.30, Oc.15 Q | 1.50 |
| New Jersey Zn | N. Y. Curb | 186½ | 185 | 186½ | Jy.20, Au.10 QX | 2.00 |
| United Zinc | N. Y. Curb | ... | ... | *55 | | |
| Yellow Pine | Los Angeles | ... | ... | *37½ | Dec. 1925 Q | 0.04 |
| **GOLD** | | | | | | |
| Alaska Juneau | New York | 1⅞ | 1½ | 1½ | | |
| Argonaut | Toronto | *36½ | *34½ | *35 | | |
| Barry-Hollinger | Toronto | *39 | *35 | *39 | | |
| Con.W.Dome L.new. | Toronto | *9 | *9 | *9 | | |
| Cresson Consol. G. | N. Y. Curb | 2 5/16 | 2 1/16 | 2⅛ | Se. 30, Oc.10 Q | 0.10 |
| Dome Mines | New York | 10⅜ | 8¼ | 10⅜ | Jn. 30, Jy. 20 Q | 0.25 |
| Golden Cycle | Colo.Springs | †1 81 | †1 80 | | Au.30, Se.10 Q | 0.04 |
| Hollinger Consol. | Toronto | 17 65 | 16 50 | 17.65 | Au. 24, Se. 9 F | 0.10 |
| Homestake Mining | New York | — | | 613 | Se. 20, Se. 26 M | 0.50 |
| Kirkland Lake | Toronto | 2 35 | 2 00 | 2 10 | | |
| Lake Shore | Toronto | 25 00 | 24 45 | 24.65 | Se.1, Se. 15 X | 0.20 |
| McIntyre-Porcupine | New York | 27¼ | 26 | 27 | Au 1, Se.1 Q | 0.25 |
| Portland | Colo.Springs | †*34 | †*30 | | Ap.6, Ap.15, Q | 0.02 |
| Rand Mines | New York | | | 48⅛ | Au.22-29 Am.Sh. | 1.52 |
| Teck-Hughes | Toronto | 9 55 | 9 20 | 9 25 | Jy.21, Au.1 | 0.10 |
| Tom Reed | Los Angeles | *47½ | *47½ | *47½ | Dec., 1926 | 0.02 |
| Tough-Oakes | Toronto | *34 | *27 | *30 | | |
| United Eastern | N. Y. Curb | | | *35 | July, 1924 | 0.05 |
| Vipond Cons | Toronto | *59 | *57 | *59 | Apr.1, Apr.15 | 0.03 |
| Wright-Hargreaves | Toronto | 7.75 | 7.45 | 7.54 | Jy.15, Au.1 SA | 0.05 |
| **GOLD AND SILVER** | | | | | | |
| Carnegie Metals | Pittsburgh | 14⅜ | 14 | 14 | | |
| Con. Cortez | N. Y. Curb | ... | ... | *18 | | |
| Con. Virginia | San Francisco | *6½ | *6½ | *6½ | | |
| Dolores Esperanza | N. Y. Curb | ... | ... | *50 | July, 1923 | 0.05 |
| Premier Gold | N. Y. Curb | 2½ | 2½ | 2½ | Se. 15, Oc. 4 | 0.08 |
| Tonopah Belmont | N. Y. Curb | 1 1/16 | 1 | 1 1/16 | Ma.15, Ap.4 | 0.08 |
| Tonopah Extension | N. Y. Curb | ... | ... | *51 | Apr. 1925 | 0.05 |
| Tonopah Mining | N. Y. Curb | 1⅞ | 1 13/16 | 1 13/16 | Ma.31, Apr.21 | 0.07½ |
| West End Consol | N. Y. Curb | ... | ... | *7 | Mar., 1923 | 0.05 |
| Yukon Gold | N. Y. Curb | ... | ... | *45 | June, 1918 | 0.02 |
| **SILVER** | | | | | | |
| Beaver Consol | Toronto | 1.77 | 1.55 | 1.63 | May, 1920 | 0.03 |
| Castle-Trethewey | Toronto | *70 | *69 | *69½ | | |
| Coniagas | Toronto | 4.90 | 4.50 | 4.50 | May, 1924 | 0.12½ |
| Keeley | Toronto | *80 | *70 | *75 | Se. 1, Se.15 | 0.08 |
| Lorrain Trout Lake | Toronto | *60 | *60 | *60 | July, 1925 | 0.05 |
| McKinley-Dar.-Sav. | Toronto | *16 | *15½ | *15½ | Oct., 1920 | 0.03 |
| Mining Corp. Can. | Toronto. | 3.20 | 3.03 | 3.10 | Jn. 29, Jy.15 | 0.12½ |
| Nipissing | N. Y. Curb. | 5⅞ | 5⅛ | 5⅞ | Jn.30, Jy.20 | 0.07½ |

| Stock | Exch. | High | Low | Last | | Last Div |
|---|---|---|---|---|---|---|
| **SILVER-LEAD** | | | | | | |
| Ahumada | New York | 6½ | 4⅞ | 4⅞ | Ma. 25,Ap.4,QX | 0.12½ |
| Bingham Mines | Boston | 48 | 48 | 48 | Jn.27, Jy. 5 Q | 1.00 |
| BunkerHill&Sullivan | N. Y. Curb | 102½ | 99½ | 99½ | Jy. 30, Au.4 X | 0.75 |
| Cardiff M. & M. | Salt Lake | *40 | *40 | *40 | Feb. 5, 1927 | 0.10 |
| Chief Consol | Salt Lake | 2.55 | 2.50 | 2.50 | Nov., 1926 Q | 0.10 |
| Consti'nMng.&Mill'g | Spokane | *21 | *15 | *15 | | |
| Erupcion | Boston Curb | *75 | *70 | *74 | Se. 15, Oc.3 Q | 0.07½ |
| Eureka Lily | Salt Lake | 1.20 | 1.00 | 1.00 | | |
| Federal M. & S. | New York | 150 | 150 | 150 | Jn.25, Jn.29 Spec. | $10 |
| Federal M. & S pfd. | New York | 94½ | 93 | 94½ | Au. 25, Se.15 Q | 1.75 |
| Hecla Mining | N. Y. Curb | 15⅝ | 15¼ | 15¼ | Au. 15 Se 15 Q | 0.25 |
| Highland-Surprise | Spokane | *10½ | *9¼ | *10 | | |
| Iron King Mining | Salt Lake | *50 | *45 | *47 | | |
| Keystone Mining | Salt Lake | | | *25 | Au. 12, Au. 26 | 0.07½ |
| Lucky Jim | Spokane | *27 | *25 | *26½ | | |
| Lucky Tiger-Com. | Kansas City | †7 00 | †6 80 | | Sept. 20 | 0.05 |
| Mammoth Mining | Salt Lake | 1.90 | 1.87½ | 1.87½ | Jn.10, Jn.20 Q | 0.05 |
| Marsh Mines | Spokane | *75 | *75 | *75 | | |
| North Lily | Salt Lake | 3.30 | 3.25 | 3.25 | | |
| Park Utah | New York | 7½ | 7¼ | 7¼ | Se. 15, Oc. 1 Q | 0.20 |
| Plutus Mining | Salt Lake | .... | .... | 2.00 | Jy. 10, Jy. 15 Q | 0.10 |
| San Rafael | San Francisco | | | *24 | | |
| Silver King Coal | Salt Lake | 8.80 | 8.70 | 8.75 | Jn. 20, Jy. 1 Q | 0.25 |
| Silversmith | Spokane | *21½ | *18½ | *21 | Oct., 1926 Q | 0.02 |
| Strattons Mines | Spokane | *43 | *41 | *42 | | |
| Sunshine M. Co. | Spokane | 1.60 | 1.55 | 1.55 | | |
| Tamarack-Custer | Spokane | *23 | *22 | *22 | Sept., 1924 | 0.25 |
| Tintic Standard | Salt Lake | .... | .... | 12.75 | Jn.15, Jn.28 | 0.40 |
| Utah-Apex | Boston | 4⅛ | 4⅛ | 4⅛ | Oct., 1926 | 0.25 |
| **IRON** | | | | | | |
| Bethlehem Steel | New York | 66½ | 63 | 64⅜ | Se. 2, Oc. 1. | 1.75 |
| Cleveland-Clifis Iron | Cleveland | 103 | 95 | 101 | Jy. 15, Jy. 25 Q | 1.00 |
| Colorado Fuel & Iron | New York | 91⅛ | 83⅓ | 85⅔ | May, 1921 | 0.75 |
| Gt. North'n Iron Ore | New York | 99⅔ | 97½ | 99⅓ | Dec. 6, Dec. 28 | 0.75 |
| Inland Steel | New York | 53⅛ | 52¼ | 52⅛ | Au. 15, Se. 1 Q | 0.62½ |
| Replogle Steel | New York | | | 12¼ | | |
| Republic I. & S. | New York | 69⅓ | 66⅓ | 68 | Au. 15, Se. 1 Q | 1.00 |
| Republic I. & S. pfd. | New York | 105 | 105 | 105 | Se. 15, Oc. 1 Q | 1.75 |
| Sloss-Sheffield S. & I. | New York | 130½ | 128 | 129⅔ | Se. 10, Se. 20 Q | 1.50 |
| Sloss-Shef. S.&I. pfd. | New York | 107½ | 107½ | 107½ | Se. 20, Oc. 1 Q | 1.75 |
| U. S. Steel | New York | 157 | 146½ | 155½ | Au. 30, Se. 29 Q | 1.75 |
| U. S. Steel, pfd. | New York | 136 | 135 | 135⅔ | Au. 1, Au. 30 Q | 1.75 |
| Virginia I. C. & C. | New York | 45 | 45 | 45 | Jan., 1924 | 1.50 |
| Virginia I.C.&C. pfd. | New York | .... | .... | 60½ | Ju. 15, Jy. 1 | 2.50 |
| **DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN** | | | | | | |
| De Beers Consol. | New York | ... | ... | 27½ | Jn. 26, Jn.30 | 1.45 |
| So. Am. G. & P. New. | N. Y. Curb | .... | .... | 2¾ | | |
| Alum. Co. of Amer. | N. Y. Curb | 105½ | 99 | 99 | | |
| Alum. Co. of Amer.pf. | N. Y. Curb | 104 | 104 | 104 | Jn. 15, Jy. 1 Q | 1.50 |
| Vanadium Corp. | New York | 55 | 52⅞ | 53¼ | Au. 1, Au. 15 Q | 0.75 |
| Patino M. & E. | New York | 20⅜ | 19⅞ | 20 | Ap. 27, My. 5 | 1 sh. |
| **ASBESTOS** | | | | | | |
| Asbestos Corp. | Montreal | 30 | 29¼ | 29⅞ | Jan., 1926 | 1.50 |
| Asbestos Corp. pfd. | Montreal | 93 | 92½ | 92¾ | Jn.30, Jy.15 Q | 1.75 |
| **SULPHUR** | | | | | | |
| Freeport, Texas | New York | 79¼ | 75⅛ | 78⅜ | Jy. 15, Au.1 QX | 1.25 |
| Texas Gulf | New York | 69⅞ | 67½ | 68¼ | Ju. 1, Ju. 15 Q | 1.00 |
| **MINING, SMELTING, REFINING AND GENERAL** | | | | | | |
| Amer. Metal | New York | 43¼ | 42⅛ | 42⅞ | Au.20, Se.1 Q | 0.75 |
| Amer. Metal, pfd. | New York | .... | .... | 110⅞ | Au.22, Se.1 Q | 1.75 |
| Amer. Sm. & Ref. | New York | 179½ | 172½ | 177⅞ | Jn 8, Au. 1 Q | 2.00 |
| Amer. Sm. & Ref. pfd. | New York | 129⅛ | 129⅛ | 129¼ | Au. 1, Se. 1 Q | 1.75 |
| Consol. M. & S. | Montreal | 241⅞ | 239¼ | 240 | Jn. 30, Jy. 15 X | 6.25 |
| Newmont Mining | N. Y. Curb | 105¾ | 98 | 100⅞ | Jn.30, Jy.15 Q | 1.00 |
| U. S. Sm. R. & M. | New York | 42½ | 40½ | 41 | Jy. 6, Jy. 15 Q | 0.87½ |
| U.S. Sm. R.&M. pfd. | New York | 50½ | 50¼ | 50½ | Jy. 6, Jy. 15 Q | 0.87½ |

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Inve.tment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

**LONDON QUOTATIONS—WEEK ENDED AUGUST 30, 1927**

| Name | High | Low | Last | Date | Amount | Last Div. |
|---|---|---|---|---|---|---|
| Aramayo Mines (25 frs.) | 76/3 | 75/— | 76/3 | Aug., 1927 | 5 | p.c. (†) |
| British Platinum (£1) | 1/6 | 1/1½ | 1/6 | Feb., 1925 | 2½ | p.c. |
| Burma Corpn. (10 rupees) | 14/— | 13/11½ | 13/3 | Aug., 1927 | 6 | annas* |
| Bwana M'Kubwa (5s) | 5/3 | 4/10½ | 5/— | | | |
| Camp Bird (2s) | 4/4½ | 3/3 | 3/9 | | | |
| El Oro (£1) | 3/6 | 3/— | 3/4½ | Nov., 1924 | 2½ | p.c.* |
| Esperanza (10s) | —/3 | —/3 | —/3 | | | |
| Frontino & Bolivia (£1) | 14/7½ | 13/9 | 13/9 | July, 1917 | 75 | p.c. |
| Mexican Corpn. (£1) | 8/4½ | 8/— | 8/— | | | |
| Mexico Mines of El Oro (£1) | 15/3 | 15/— | 15/— | Dec., 1926 | 3¾ | p.c.* |
| N'Changa Copper Mining | 9/— | 7/6 | 7/6 | | | |
| Oroville Dredging (£1) | 4/3 | 4/1½ | 4/3 | Dec., 1923 | 3¾ | p.c. |
| Ouro Preto (£1) | 2/6 | 2/— | 2/— | May, 1925 | 2½ | p.c. |
| Rhodesian Congo Border (£1) | 46/3 | 40/— | 42/6 | | | |
| St. John del Rey (£1) | 10/6 | 9/3 | 10/ | May, 1927 | 3¾ | p.c. |
| San Francisco Mines (10s) | 28/1½ | 27/— | 27/3 | July, 1927 | 15s. | |
| Santa Gertrudis (£1) | 16/ | 15/6 | 15/10½ | July, 1927 | 7½ | p.c. |
| Selukwe (2s. 6d.) | 8/9 | 8/8½ | 8/9 | April, 1917 | 6¼ | p.c. |
| S. Amer. Copper (2s.) | 3/— | 2/9 | 2/9 | Nov., 1917 | 75 | p.c. |
| Tanganyika (£1) | 64/9 | 50/— | 54 4½ | Aug., 1926 | 7½ | p.c. |
| Union Miniere du Haut-Katanga (Brussels) | 9.850 | 9.725 | 9.750 | July, 1927 | 182.60 | (‡) |

* Free of British income tax. † Swiss francs and plus 15 p. c. bonus. ‡ Belgian frs. and free of taxation.

# Modern Equipment

## A New Continuous Vacuum Filter

A distincntly new type of continuous vacuum filter has been introduced for general filtration work by the Dorr Company of New York. In it several new features are incorporated which give it a relatively wider field of application than the usual type of vacuum filter.

As shown in Fig. 1, the filter medium is applied on the inside of the drum. The division of the total filter medium into several sections or panels makes it possible to change all of the cloth or any panel of it by removing the wood strips which secure the medium

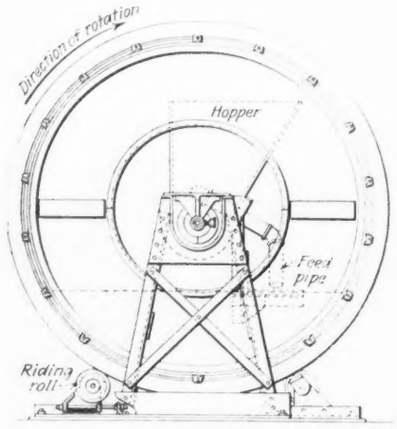



*Fig. 1. Sectional end view of the new filter*

to the drum. Vacuum for cake formation, drying, and washing, and air for cake discharge are applied to the panels through a port valve of the usual type adjacent to the closed end of the drum. All piping is on the outside of the drum and is easily accessible.

The drum, at its open end, is provided with an internal flange which serves to retain the pulp within it during filtration, thus eliminating the filter tank. Fig. 2 shows the feed pipe extending into the drum through the trunnion at the closed end of drum, although the feed may enter through either end as desired. The cake is discharged from each panel in turn by pulsating air admitted between the cloth and the shell by a special valve which is driven from the filter counter shaft. The filter cake drops into a hopper inside the drum and is removed by a screw conveyor.

A trunnion-bearing supports the filter at the closed end. The drum is supported near the open end by a trundle which bears the tire, and which is secured to the shell. The rollers are mounted on the main filter baseplate. The drum is rotated by means of a worm and worm-gear drive and turns in a clockwise direction. The filter is furnished with direct motor drive or is arranged for belt drive from a line shaft.

It will be seen at once that in the Dorrco filter, as the new filter is called, gravity aids filtration by causing the particles to tend to segregate directly against the filter medium. Fig. 3 represents a cross section through the filter drum showing the direction of segregation of the relatively coarse particles which takes place in substantially the same direction as in a graduate filled with pulp. This feature is of considerable importance since segregating and dilute pulps may be handled readily; relatively coarse, quick-settling material may be contained in the feed, agitators and air lifts to keep the solids in suspension are not required, and, after a shut down, operation may be resumed without any tendency for the settled material to stall the machine.

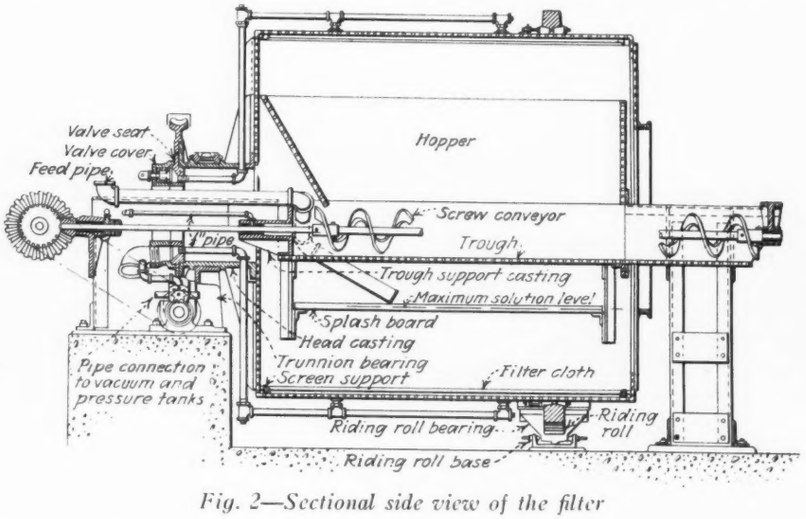



*Fig. 2—Sectional side view of the filter*

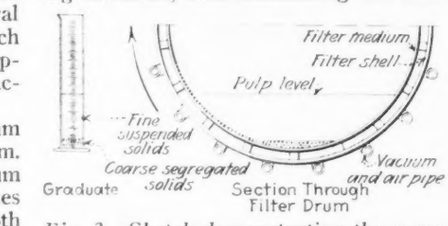
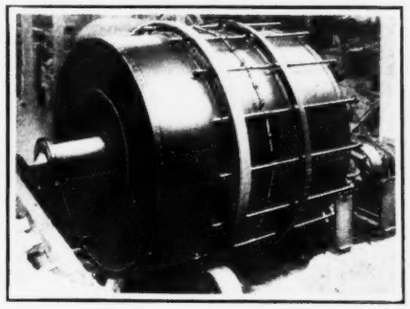



*Fig. 3—Sketch demonstrating the segregation of the pulp in the new filter*

Since particles of the same specific gravity settle at different rates according to their relative size and shape, the coarsest particles in the feed form that part of the cake which lies next to the filter medium while the finest ones are the furthest removed from the cloth. This minimizes the tendency of the fines to work into the pores of the cloth and thereby assures a uniformly high filtration rate and a long life for the filter medium.

One large Dorrco filter has been in commercial operation for over a year and other units have been operating for some months. While the ability of this filter to handle coarse material is one of its most interesting features the unit is equally well adapted to handling the other pulps which are generally dewatered on vacuum filters.



*The new continuous vacuum filter of the drum type, as it appears installed*

The new filter was developed by J. T. Shimmin at the plant of the Chino Copper Co., at Santa Rita, N. M.

## Rand Mine Installs Large Fan

The specifications of the ventilator fan recently installed at the Government Areas mine is as follows:

| | |
|---|---|
| Duty, cu. ft. per minute | 900,000 |
| Water gage, in. | 7 |
| Diameter of impeller, ft. | 30 |
| Diameter of fan shaft;—Center, in. | 21 |
| At journals, in. | 13 |
| Weight of impellers and shaft, tons | 30 |
| R.p.m. | 125 |

The fan is driven by a direct-coupled tandem horizontal steam engine using steam at 140 lb. per sq.in. gage pressure and 100 deg. superheat. The guaranteed mechanical efficiency of the fan is 75.5 per cent at full load and the steam consumption 12.5 lb. per hp.-hr. Cylinder diameters are 26 in. and 52 in., stroke 36 in.; at maximum speed of 125 r.p.m., this unit develops 1,500 horsepower.